Engineering News-Record

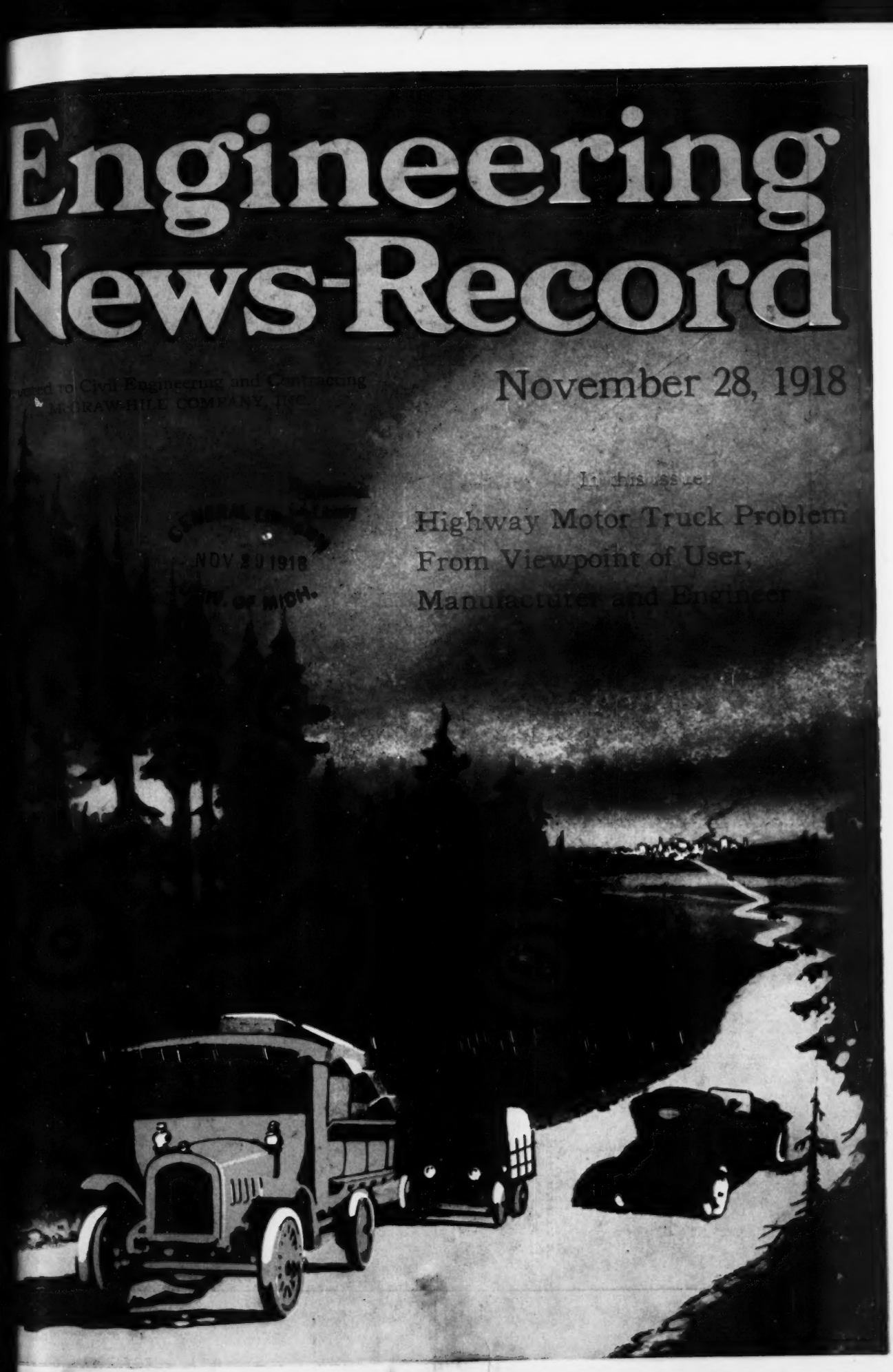
Devoted to Civil Engineering and Contracting
McGRAW-HILL COMPANY, INC.

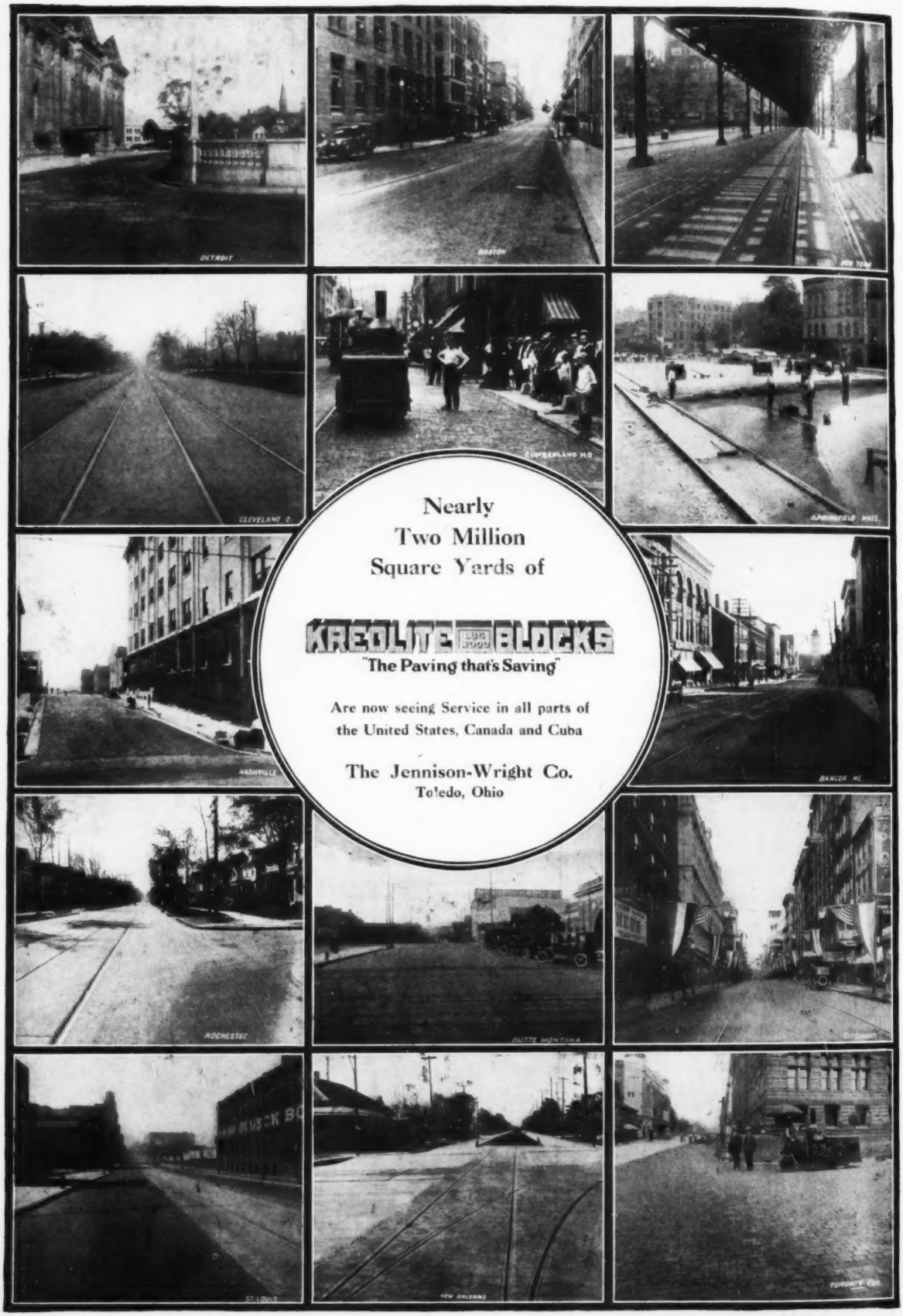
November 28, 1918

GENERAL LIBRARY
NOV 29 1918
UNIV. OF MICH.

In this issue:

Highway Motor Truck Problem From Viewpoint of User, Manufacturer and Engineer





Nearly
Two Million
Square Yards of

KREOLITE BLOCKS

"The Paving that's Saving"

Are now seeing Service in all parts of
the United States, Canada and Cuba

The Jennison-Wright Co.
Toledo, Ohio

Volume 81 November 28, 1918 Number 22

Engineering News-Record

A CONSOLIDATION OF ENGINEERING NEWS AND ENGINEERING RECORD, WITH WHICH IS INCORPORATED THE CONTRACTOR.

E. J. MEHREN, *Editor*
CHARLES WHITING BAKER, *Consulting Editor*

Highway—Motor Truck Problem as Viewed by User, Manufacturer and Engineer 968
BY GEORGE H. PRIDE, EDWARD L. VIETS AND H. ELTINGE BREED.
Engineering News-Record, Nov. 28, 1918. 20 cols. Ill.

Great Lakes Yards Lead Coast Districts in Building Ocean-Going Ships 978
PRODUCE CANAL-SIZE STEAMERS in large numbers—Spirit of coöperation—Yard capacity doubled—Side launching—No outside fabrication—Equipment of varied character—Labor shortage.
Engineering News-Record, Nov. 28, 1918. 6 cols. Ill.

Road Maintenance Methods and Devices Effect Saving of Material, Labor and Fuel 981
BUREAU OF MAINTENANCE AND REPAIR, New York State Highway Department, working through nine division engineers, endeavors to keep the war-traffic roads open and still conserve material.
Engineering News-Record, Nov. 28, 1918. 6¾ cols. Ill.

Light-Traffic Railway vs. Highway and Motor Truck 984
BY CLEMENT C. WILLIAMS.
ANALYSES OF OPERATING EXPENSES, fixed charges and amount and kind of traffic should be made for each case.
Engineering News-Record, Nov. 28, 1918. 2¾ cols.

Different Types of Framing in Two New Government Reinforced-Concrete Ships 986
7500-TON OIL TANKER has close-spaced frames with vertical and horizontal reinforcing in shell, while 2500-ton schooner barge has long-span framing system with diagonal shell reinforcement.
Engineering News-Record, Nov. 28, 1918. 7¼ cols. Ill.

Capacity of Macadam Roads for War Business Increased 990
THREE-FOOT concrete shoulders added at each side without closing highways to traffic—War labor conserved by using convicts for the construction.
Engineering News-Record, Nov. 28, 1918. 5¾ cols. Ill.

What and Where to Buy 154

Comparison of Excavation Haulage by Motor Trucks, Industrial Railways and Teams 993
DETAILED COST ACCOUNTS on the construction of the Brooklyn Army supply base show that trucks are more economical than teams and less economical but more flexible than railways.
Engineering News-Record, Nov. 28, 1918. 6 cols. Ill.

City Plat Disapproved Because Not Suited to Topography 996
Engineering News-Record, Nov. 28, 1918. ¾ col.

Ford Car Cleans Water-Works Reservoir at Trenton, N. J. 996
BY W. COMPTON WILLS.
Engineering News-Record, Nov. 28, 1918. 1¼ col. Ill.

Salesmen of Engineering Equipment for Export Must be Engineers 997
BY S. T. HENRY.
MUST INTRODUCE not only American machinery but American methods—Showing economics of use most important factor.
Engineering News-Record, Nov. 28, 1918. 4¼ cols.

Editorials 965

Letters to the Editor 999

Hints for the Contractor 1000

News of the Week 1002

News of Engineering Industries 1007

Construction News 255

Index to Advertisers 160

Searchlight Section 72-100

McGRAW-HILL COMPANY, INC., 10th Avenue at 36th Street, NEW YORK

JAMES H. McGRAW, President
ARTHUR J. BALDWIN, Vice President
E. J. MEHREN, Vice President
EDWARD CALDWELL, Treasurer
JAMES H. McGRAW, JR., Secretary

WASHINGTON, D. C., 1410 H Street, N. W.
CHICAGO, Old Colony Building
PHILADELPHIA, Real Estate Trust Building
CLEVELAND, Leader-News Building
SALT LAKE CITY, 519 Newhouse Building
SAN FRANCISCO, Rialto Building
LONDON, E. C., 6 Bouverie St.

Cable Address: "Machinist, N. Y."

Publishers also of
Electrical World
American Machinist
Power
Engineering and Mining Journal
Electrical Merchandising
Coal Age
Chemical and Metallurgical Engineering
Electric Railway Journal

United States, Mexico, Cuba, Porto Rico, Hawaii or the Philippines, $5 per year; Canada, $7; elsewhere, $9. Single copy, 20c.

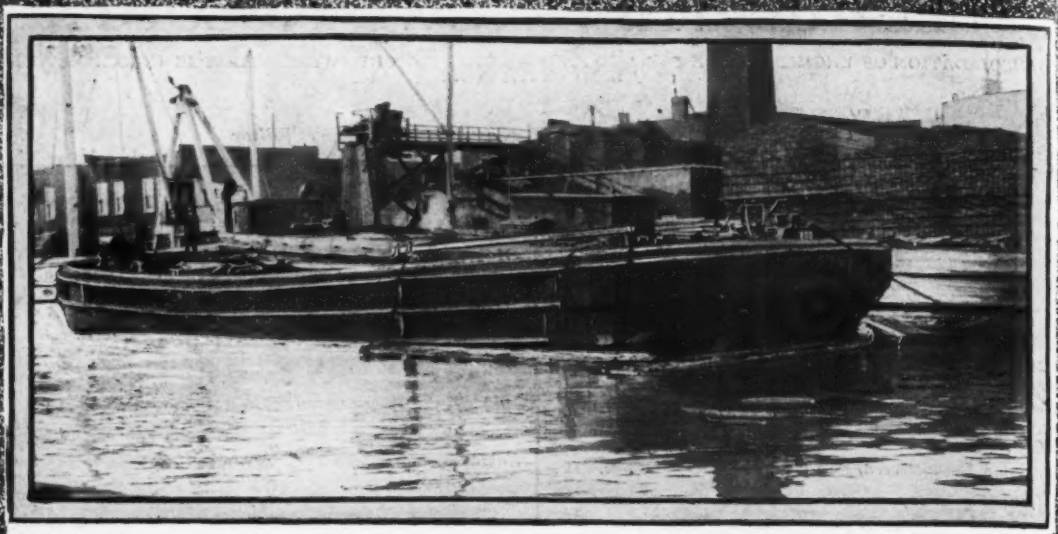
No back volumes for more than one year and no back copies for more than three months.

Change of Address—When change of address is ordered the new and the old address must be given. Notice must be received at least ten days before the change takes place.

Copyright, 1918, McGraw-Hill Company, Inc. Published Weekly. Entered as second-class matter Apr 11, 1917, at the Post Office at New York, under the act of Mar. 3, 1879.

Member Audit Bureau of Circulations. Member Associated Business Papers, Inc.

CIRCULATION OF THIS ISSUE, 32,220 COPIES



Reinforced-Concrete Tanker, Standard Oil Co., New York. Built by Fongner Concrete Shipbuilding Co., Inc.

THIS Company is operating strictly according to the rules and regulations as laid down by the War Industries Board, at Washington.

According to their ruling, we will only accept orders for Havemeyer Bars which are to be used on Government work or essential industries, as defined by the War Industries Board, Priorities Division.

Havemeyer Bar Service

is available for use on

CONCRETE SHIPS

as this industry is considered essential by the United States Government

HAVEMEYER PRODUCTS

can be used economically for holding and tying bars together on concrete ships.

Write us for further information.

CONCRETE STEEL COMPANY

42 Broadway, New York

Boston Philadelphia Birmingham Chicago Cleveland Syracuse Washington

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

Volume 81 — NEW YORK, THURSDAY, NOVEMBER 28, 1918 — Number 22

Stirring Up Labor Troubles

HOW badly high ideals are needed for the reconstruction program has already been shown by the outburst, in the very week of the armistice, of William H. Barr, president of the National Founders' Association, regarding labor, and the immediate, belligerent reply of Mr. Gompers. It is exceedingly unfortunate that Toryism should so foolishly have shown its head, and Mr. Barr's belated word that he was not seeking strife cannot remedy the situation. The evil has been done. By taking a conciliatory attitude in the first instance, by urging that "justice and humanity" rule in the adjustment of the labor situation, he could have helped instead of hindered the orderly solution of this very difficult problem. There are many Tories still in the employing ranks, believers in the divine right of kings to do as they please, but happily the leaders among our business men see that for the best interests of our country "justice and humanity" must prevail. But how much it would help if this slogan were universally adopted and the outbursts of the Barrs be thus prevented!

A Highway Issue

THIS issue, devoted in large part to highway matters, is published to anticipate by a week the great highway convention which is to convene in Chicago in the week after next (Dec. 11 and 12). By its appearance a week in advance it will serve to emphasize again the importance of that meeting. The convention, coming as it does after a period of curtailment in highway work, after the marvelous war-demonstration of the utility of highway transportation, and at the beginning of an era of probably unprecedented highway expansion, pulls strongly upon every man who is concerned with highway problems. The principal questions to be discussed will be the public road policy of the future and the relation between the two instruments of highway transportation—the road and the vehicle. As a contribution to the discussion of the latter question there are given, beginning on p. 968 of this issue, the views of representatives of the three chief parties at interest in highway transportation—the user, the vehicle manufacturer and the engineer. We commend most heartily these articles to our readers, particularly as all three interests agree that the five-ton truck is the desirable maximum under present conditions. We commend, too, the vigorous introductory paragraph of Mr. Breed's article and that paragraph in which he urges the use of those types of pavement only which have proved equal to the heaviest traffic. Every engineer and taxpayer should be at one with him when he says: "The demands of traffic are upon us. We have lagged behind since 1902. For the sake of national prosperity, we can't afford to lag behind any longer; we can't afford to squander wealth and energy upon experimentation with unsatisfactory types." We must all agree that there has been not only too much experimentation but too much blind persistence in the use of types that clearly have no place in present-day trunk highway construction. This view will surely be one of those that will be emphasized at the Chicago convention.

Efficient Shipbuilding Along the Great Lakes

MEN accurately informed about shipyard work throughout the country say that the yards on the Lakes are building ships at lowest cost. These same yards have established a remarkable record of output, as told on page 978, by contributing during many months one-third of the entire steel-ship tonnage delivered to the Emergency Fleet Corporation. Because of this twofold distinction, the methods of the Lakes shipyards have a peculiar claim on the attention of shipbuilders. A series of articles on those methods, beginning in this issue, has been prepared, to furnish a basis for study. Economy of hull construction is certain to become steadily more important in the development of the American shipbuilding industry. Full exchange of knowledge between the various shipyard districts of the country is the best means of furthering progress in this direction. But in any analysis of the work along the Great Lakes one point must be taken into account: Perhaps outweighing method, the spirit of energy animating the shipbuilders of the inland seas is an essential part of the secret of their achievements.

Shipyard Efficiency Reflected in Riveting

PROGRESSIVE improvement in shipyard rivet-driving, despite a continuing shortage of trained men, is an index of efficiency in yard management. In the development stage of the yards, shipbuilding operations could not be organized in such a way as to yield a high output per man. This was as true of shops, transportation and erection work as of riveting, but the detailed recording of performance for the latter made it the outstanding element of the shipbuilding situation. Improvement of the production system in the yards correspondingly finds expression in higher

riveting figures. Piecework payment is one of the instruments of efficiency. Yard tests have proved conclusively that time payment gives inferior rivet outputs; yet during the period when the yards were not fully organized for the extra burden of work placed upon them, when speed had to be secured at the cost of efficiency, piecework riveting was not everywhere practicable—in some instances it was impossible even to supply work regularly enough to enable the gangs to make fair earnings on piecework. Since then, extension of piecework and rise in rivet output have gone hand in hand. The shipyards are working under full pressure, and specialist training is helping to solve the remaining difficulty of labor supply.

Concrete Consistency Criterion Needed

TESTS have demonstrated that there is such a thing as precisely the right amount of water to mix in a batch of concrete. More or less than this amount reduces compressive strength. On the actual job, however, such things as the method of placing or the size and congestion of the forms make it usually necessary to use a different proportion of water than that which will give the greatest strength in an isolated specimen of the same concrete under laboratory conditions. This variation from the optimum amount of water must be regulated by the skill and experience of the director of the concreting, so that in spite of the accepted necessity for a definite water content there is today more difficulty in determining the proper consistency of a concrete mix than there was in the old days when the amount of water used was a more or less negligible factor. What is lacking is some definite criterion of consistency which may be used as a measure of future strength. The need for this criterion is nowhere more clearly seen than in the manufacture of the numerous concrete barges and ships now under way. Ship concrete must be of the best. The thin walls must be of maximum density and strength. Both engineers and contractors in the various yards are at one in their efforts to produce the best possible material under the conditions, but in practically every yard during concreting there is a controversy, generally amicable—though sometimes toward the end of a thirty-six-hour continuous run somewhat acrid—between the engineer who is insisting on a mix of what he considers optimum dryness and the contractor who wishes to put in sufficient water to insure the easy flow of the concrete around the steel. So long as the measure of consistency is in the eye of the expert, just so long will there be this difficulty.

Is the Shipping Program to Be Ruthlessly Cut?

RUMORS credit the Shipping Board with reducing the number of concrete ships at each of the five Government yards from eight to two, and with putting the full responsibility for construction and costs into unfriendly hands. We hope that the report is not true. Such action will brand the board as definitely unfair to the concrete ship and, what is more vital at this critical period, will unsettle the whole shipbuilding industry. The successful completion of the 12,000-mile voyage of the concrete freighter "Faith" lifts the concrete ship from the plane of the experimental. Concrete vessels can be built that will safely carry ocean freight; their future depends on cost, not on structural stability. Unless the new Government concrete ships are made in sufficient numbers to absorb the cost of the yards already built and material already purchased for multiple ship production, the few ships assigned to each yard by the reported curtailed program will be commercially impracticable. Is the Shipping Board willing to take the responsibility for killing so promising an addition to the American merchant marine by such a subterfuge?

If the concrete ship is a failure, let the board cancel all the contracts and shut down all the yards. This is no time to send good money after bad. If it is economically doubtful, let the new construction program be concentrated in one or two yards, so as to assure efficient production. But we are entitled to know how and why the concrete ship has failed, if that is the opinion of the board.

But the greater danger from this rumored action lies in the evidence it would afford of a thoughtless cutting of our shipbuilding program. If the concrete ship program is to be so summarily dealt with, who knows what will be done with the other programs? The fabricated ship is also an experiment, an experiment in construction methods. Will the capital and labor interested in the fabricating yards soon have to look to other fields of endeavor? As we pointed out last week, this is no time for hasty action in shipbuilding control. Every move today will be reflected in our industrial conditions and our marine position a year from now. The gentlemen at Washington and Philadelphia who administer our ship program are responsible to the people not only for this mortgage on the future but for the money they are now spending. Their trust today is quite as solemn as it was when all that was required of them was to produce ships regardless of cost.

Minute Mix Justified by Extensive Tests

FOR some years "a batch a minute" has been a slogan of concrete-mixer manufacturers. It implies a time allowance which on the one hand was rarely reached in rush concreting or under lax inspection, and on the other was frequently condemned as too short by the theorists. These latter, backed by a few tests, assumed that increase in time of mixing made a proportionate increase in the dispersion of the cement through the mass and consequently a proportionate increase in the strength of the resulting concrete. The limit of this proportionality was not definitely fixed, nor was the curve of increase assumed to be a straight line; they believed that 2 min. was enough better than one to justify its specification, and that 5 min. was better still, though perhaps not warranted economically. Tests of unprecedented extent are now available to show that the mixer makers were the nearer right of the two. The tests, of course, refer only to the present state of the art and to the drum type of mixer. In other words, they tell nothing about the possibilities of long-time mixing with different types of incorporation.

Those tests, a part of a most elaborate series on the whole subject of concrete making reported by Prof. D. A. Abrams of Lewis Institute before the last meeting of the American Concrete Institute, are now just about to be made available in the *Proceedings* of the institute. They show that while there is an increase in strength with time of mixing in a 3½-ft. batch mixer, the curve of increase drops off quickly after from 45 sec. to 1 min. For instance, the average of all the tests, numbering more than 3000, shows that the increase in three months' strength from 1 to 2 min. mixing is about 7%; from 1 to 5 min., about 15%, with no further increase for the 10-min. mix. Between ¾ min. and 1 min. the increase was about 6%. Many of the tests showed no important gain in long-time strength by mixing longer than 1 min., although the 7-day and 28-day strength seemed to be raised. On the basis of these tests Professor Abrams rightly concludes that 1 min. in the mixer gives maximum concrete efficiency in so far as mixer output is concerned, and recommends that this period be adopted as standard. So many other factors enter into the strength of concrete that prolonging the mixing period is of doubtful economy. Then, too, the occasional inevitable failure to meet that time by a few seconds will not cause any dangerous loss of strength.

One minute of turning in the drum, the logical deduction from the tests, is not, however, the same thing as "a batch a minute." The manufacturers' slogan is justified only to the degree that the mixing plant is operated efficiently. In some plants the mixer's inactive moments are practically negligible, so rapidly does loading follow dumping, but to turn out 60 batches per hour and yet approximate a 1 min. mixing time for each requires a fine coördination of all parts of the plant, in which the mixer is only a small part. The 1-min. mix will give good concrete, acceptable to any engineer, but the contractor working to such a specification must have the best of plant design and operation if he expects to approach the mixer manufacturers' standard of economical operation.

A New Era in Highway Transportation

LOOKING back over the period of the war, one is amazed at the increase in the use of the highways for motor transportation. The four years of conflict have put us in a new era. The various problems involved in carriage over the roads have increased immensely in importance. The danger is that we may fail to grasp the true import of the war's lessons and think and plan on a scale far below the demand or the opportunities.

Before the war who could have suggested without incurring ridicule the transportation of an army division of 38,000 men, with all its equipment, over a distance of 160 miles in 16 hours? Who could have anticipated a motor-transport system, such as saved Verdun, when for two and a half months, day in and day out, a truck passed a given point in each direction every 22 seconds? Who could have said without being dubbed a dreamer that the inadequacy of our rail transportation system would force the use of motor trucks for long-distance express service between points as far apart as Washington and New York? Such developments were beyond the expectations of even the most enthusiastic highway advocates five years ago; today even the man in the street regards them as commonplace.

Nor is the mere number in use or the length of runs the full measure of the motor truck's value. It has demonstrated an adaptability that is truly staggering. At home no service has seemed too severe for it, nor any commodity—the most delicate, the most unwieldy, or the most bulky—impossible of accommodation. In the war zone motorized ambulances and operating rooms, motorized artillery and ammunition supply trains, motorized kitchens and ice-making plants, motorized sanitation apparatus and even bath-houses, testify to the universality of its use. Carrying its terminal facilities with it—picking up its load at point of origin and discharging it at ultimate destination without the mediation of any other mode of carriage—it has proved immensely superior to rail transportation for speedy service on the relatively shorter hauls.

The vehicle, then, has demonstrated its value. But it is only one factor. What of the track, the highway? Has it proved equally satisfactory? Has it kept pace with the development of the truck or with the demand put on the roads?

We need not make answer. The facts are spread plainly before all who would see. Road work has not kept pace. It was under restriction, but we are sure that even had there been no war-imposed curtailment the highway would have fallen behind. As it is, roads with inadequate surfaces or foundations, or weak in both respects, have gone to pieces, and states are reckoning in millions of dollars the money necessary to restore them ever to their former condition, while the aggregate sum necessary for bringing trunk highways up to the standard required by the new vehicle runs into billions.

What of the future? With the past four years of surprises behind us, who can say what the next decade will develop? Certainly, the problem is one of national scope; it affects the average citizen just as directly and seriously as does rail transportation, which was once a subject of Federal subsidy and has always been one of national concern. Only a national attack is commensurate with the magnitude and importance of the road problem today.

With these facts undisputed, and the great after-war reconstruction period opening before us, it is fortunate that the American Association of State Highway Officials and the Highway Industries Association are inviting the highway interests of the country to meet in Chicago, Dec. 11 and 12, to discuss the plans and policies necessary for meeting the highway situation of the minute. Both associations have displayed a broad and vigorous conception of road necessities during the war, so that the atmosphere carried to the meeting by the sponsors will be favorable to a progressive and adequate presentation of the subject.

That highway construction must be expedited is conceded by all. Upon it depends not only the conservation of the present investment in roads, but the giving to the people of the benefits of reduced transportation charges. Broad plans and vigorous action alone have place today. The Chicago convention, we believe, will be instrumental in developing the one and offering the needed inspiration for the other.

Highway—Motor Truck Problem as Viewed by User, Manufacturer and Engineer

In the following articles will be found the views of representatives of the three parties most directly interested in highway transportation—the user of the road, the manufacturer of the vehicle and the engineer responsible for the track. Happily, the articles agree as to the desirable maximum size of truck—that of 5-tons capacity. Mr. Pride, as a user, argues on grounds of utility and economy, Mr. Viets, who through close association with the industry is familiar with the manufacturers' problems, bases his conclusion on structural considerations, while Mr. Breed declares that roads can be constructed and maintained economically for the 5-ton truck. If this agreement between user, manufacturer and engineer is general—and we believe that it is—it should not be difficult, through vigorous coöperation, to secure legislation which will be satisfactory to all parties and insure the conservation of the interests of the public, both as the owner of the roads and the ultimate beneficiary of economical highway transportation.—EDITOR.

Limitations To Be Placed on Trucks, From User's Viewpoint

BY GEORGE H. PRIDE
President, Heavy Haulage Company, New York City

MOTOR trucks, by whomsoever considered, must be viewed from the point of view of their utility. This utility is the logical basis for good-roads expansion to accommodate any means of transportation, and the motor truck is preëminently utilitarian. Roads should not be built unless they can be made productive, and the only way to make them so is by economical transportation. Trucks have come to stay, and the time is ripe for the burying of antagonism between those interested in them, and for coöperation in determining the characteristics of the most economical truck and providing a track to carry it.

The history of the growth of motor-truck operation follows very closely the precedent of passenger-car operation. That this should be the case is very natural, because at first motor trucks were built, almost without exception, by companies which manufactured passenger cars, and they were merchandised by passenger-car selling organizations.

GREAT CHANGE IN PUBLIC OPINION WITH RESPECT TO MOTOR CAR

It requires no strain on one's memory to recollect that less than ten years ago the owner of a passenger car was looked upon by the general public as a privileged person, who was using the roads for his own benefit, causing excessive wear and tear by the speed of the vehicle and the friction of the tires on the road surface, and jeopardizing the lives of the community at large. The antagonistic attitude of the general public was shown very plainly by laws and ordinances which the owners of automobiles regarded as unduly restrictive. That they were so is generally indicated by the modification of these laws as the years have passed. As the use of passenger cars became more general, owing to the greater prosperity of the country and the decrease in the cost of cars, the viewpoint altered, changing so completely that it is only when one thinks back several years that one realizes what a tremendous modification has taken place in the minds of the public.

Motor trucks have been produced commercially for more than a decade, but their growth has been very slow, as compared with the growth of the passenger car, and consequently they have not as yet become so closely interwoven into the lives of the people at large as to eliminate the prejudices which are so prevalent in the initial stages of the development of any mechanism.

Probably the first converts to the belief in the utility and desirability of passenger cars, and the greatest supporters of their development, aside from those owning them, were the officials of the state highway departments. This was logical, because they realized that the use of passenger cars would increase considerably the wear on road surfaces, and they appreciated the fact that the use of these vehicles would serve to stimulate the interest of the general public in their work. This would mean that they would get greatly increased funds for their road-building plans.

Another feature favoring the development of the automobile was its pleasing appearance, and it is perhaps to be regretted that the motor truck seldom is a comely sight. Because it is made for purely utilitarian purposes, the same effort is not made to secure noiselessness of operation, and, on account of its more or less objectionable noisiness, the motor truck tends to produce a rather unfortunate impression on the minds of those who look at it as a vehicle rather than as a medium for transportation of freight.

ROADS MUST BE PRODUCTIVE

Obviously, money expended in the building and maintenance of highways would be a hideous economic waste, if, after the highways were built and bettered, they were not productive, and the only general way in which a highway can be productive is by furnishing a means for transportation. The use of highways by passenger cars is utilitarian to a certain degree, but it must be remembered that the use of the highways by motor trucks is always for business purposes; in other words, nobody ever engages in the operation of a motor truck for pleasure. It must also be remembered that when passenger cars were first operated it was purely for pleasure, but as their use became more general they developed a distinctly utilitarian purpose,

while the useful function of the motor truck always has been its sole function and always will be. For this reason the farsighted highway official, judging from his past experience with the passenger car, can look forward to the motor truck as a force, infinitely greater than the passenger car—great as that has been—to strengthen his efforts toward increased highway development.

Apparently, to the minds of some highway officials who have regarded it from a somewhat antagonistic viewpoint, the motor truck has appeared in the same light as the passenger car used for pleasure purposes—that is, it has been considered as using the highways for purely private gratification. This, of course, emphatically is not the case. It is quite plain that this is not so with respect to motor trucks operated as express vehicles or common carriers, because these vehicles afford transportation for the public at large. It might appear to be the case with those which are used for transporting a commodity manufactured by the company which owns the trucks, but even there it is not so, for, owing to severe competition, no commercial organization will employ motor trucks unless they transport goods more economically than any other means requisite to meet the situation. In the effect on the selling price of their goods, the general public benefits to this extent. Therefore, no motor truck is a private utility, because, either directly or indirectly, the ultimate consumer pays the cost of all transportation of the commodities that he uses. If the cost of transportation is lessened by the motor truck, he gets the benefit of the decrease; or, conversely, if it should be increased by unduly restrictive legislation, he would be penalized to the extent of the added expense.

Antagonism Between Interested Parties to Be Deplored

There has been a great deal of discussion in various sections of the country in the past few years regarding the size, weight and speed of trucks which should be permitted on the public highways. There was even a question in the minds of some people as to whether it was not desirable to prohibit their use entirely, but since the war started they have so plainly exhibited their value that this last question can no longer be considered. The motor truck has come to stay, and within the past two years has become more closely interwoven in the commercial fabric of this country than is generally realized. But there has grown with its use a most unfortunate feeling of antagonism between the truck operators and the state highway officials. Nothing could be more deplorable, because, instead of their interests being antagonistic, they are absolutely identical. It is obvious that motor trucks cannot operate unless there are good roads, and under the economic pressure of the reconstruction period, while we all anticipate an enormous road-building campaign, assuredly no roads will be built in the coming time of stringent economy unless the money so invested will be greatly productive to the community which provides the funds.

In some states it is considered that the 3-ton truck is all that the roads of the state can adequately carry. In other states, a limitation of 28,000 lb. per vehicle (which means the 7½-ton motor truck) has been decided upon as the maximum. Now, whatever is enacted in any of these states, unquestionably those concerns operating trucks in that territory will comply with the law, but, generally speaking, the smaller the tonnage of the motor-truck unit, the greater cost per ton for the freight it transports. Therefore, those communities which pass the 3-ton law will obligate their citizens to pay a considerably increased transportation cost over that paid by the communities where heavier units are permitted. Granted that there is a given volume of tonnage to be hauled, it means that a greater number of trips will be required to carry this tonnage if 3-ton trucks are used than if 5- or 7½-ton trucks are used. Where the 3-ton limit is in force, it unquestionably means greater surface wear, although there is the converse that there is less disturbance of the road foundation than with the heavier unit.

Transportation Costs Greater with Smaller Trucks

In considering this increased cost of transportation by 3-ton units, it might appear to the layman that if there would be less deterioration of the roads with the 3-ton than with the heavier units, it would be desirable to place the limit at 3 tons. There, again, a very dangerous situation arises. It has been said, and is probably true, that the majority of commodities, before they reach the ultimate consumer, are transported over the highways from five to ten times during their process of evolution, and in many instances much more frequently. Therefore, if the cost of transportation, owing to the limitation of motor trucks to 3-ton units, were increased 20% (and this I think is a very conservative estimate), and if this 20% increase in transportation cost were multiplied the number of times all these commodities are so transported before they reach the ultimate consumer, an added transportation expense that is quite amazing is developed.

From the foregoing, it has seemed to me that the test as to whether or not a highway is justified is not determined solely by the number of years that it exists before it needs to be resurfaced, but rather by its productivity as measured by the tonnage carried, together with the degree of economy with which this is accomplished. With the advent of the motor truck, the highway ceases to be a mere line of communication between two points; it becomes part of the transportation system of the United States, and its value should be estimated by its yearly tonnage and the cost of haulage per ton-mile, rather than by the cost of building the road and its life in years.

Do Trucks Cause the Damage Ascribed to Them?

There are many opinions expressed as to the damage done to the highways by motor trucks. Some of these are true, but many of them are gross misapprehensions. I cannot help feeling that the development of the motor truck has reached such a point, and its future use is going to be so enormously increased, that the time has come when a series of tests and observations should be made by a committee composed of highway engineers and those interested in the operation of motor trucks,

to determine what effect the motor truck has on all types of highways. From observation of the condition of roads of many descriptions for a period of years, I have formed conclusions which I hesitate to cite here, as they are utterly at variance with opinions that are so popular at present.

I feel that the antagonism between those interested in highway construction and those interested in highway operation should be buried, and that the time is now ripe for the utmost coöperation—first, in finding out what is and what is not detrimental in the way of weight, speed and size of motor trucks, and, second, in making a united effort to put the results of these findings into effect. This should be done for two reasons: First, that the country as a whole may be benefited, and second, for the greater success of both interests involved.

In conclusion, it is my opinion that the 5-ton truck, which, when loaded, weighs about 25,000 lb., has been the most economical unit for general use in haulage. Among the many reasons found for this there are two general reasons which may be stated. In the first place, the larger trucks, above the 5-ton capacity, as constructed today, move much more slowly than the lighter trucks. Therefore, though they are able to carry greater loads, the time lost on account of the lower speed about counterbalances the saving effected. Whether or not this is a mechanical feature which cannot be corrected I do not know, but it has been the case up to the present time. The fact that many companies which formerly made 7½-ton trucks have now dropped back to the 5-ton capacity might lead to the belief that there is a mechanical difficulty.

Merchandise Handled in 5-Ton Lots

A second reason why the 5-ton truck is more economical and convenient is found in the fact that it is natural to think in fives and tens, as in the decimal system. Merchandise is sold in 5-, 10- and 20-ton lots, and it generally happens that the motor-transportation company receives orders for transportation in these lot sizes. If it operates with 5-ton trucks, one, two, or four will fill the bill, but if it has 7½-ton trucks it is probable that one load will be short or all of them will be below capacity. However, it seems reasonable that an additional margin of about 10% over the 5-ton capacity should be provided, because it is unwise to bind too closely by present precepts an engineering development, thus inhibiting any possibility of its progress. I am therefore of the opinion that 28,000 lb. should be the maximum gross weight permitted on four wheels; that 15 miles an hour should be the maximum speed, and that the width of the motor truck should not exceed 7½ ft. at its widest point.

In the matter of speed, I feel that 15 miles an hour for the heavier trucks should be the maximum, because, owing to stops and starts, grades, the necessity of using care in passing vehicles, etc., it is necessary to have this rate of speed to enable the average truck in a 10-hour day to maintain the mileage of from 50 to 60 miles. (This figure, of course, does not refer to those trucks which are making long-distance hauls between two cities, but these are exceptions).

Whatever may be the immediate limit placed upon the motor truck, it is my judgment that it must not be considered final. We are on the eve of vast developments, and requirements of the future will demand greater weights, better and different types of roadbeds, reduced grades, etc. It is a matter for consideration whether tracks of steel or cast-iron channels, or the use of some other material which would combine great wearing value with greater tractive friction than these, should not be substituted for our present roads. If this were done, the material wasted in paving the central section of the roadway could be used in giving stability under the rails.

Factors Which Will Govern Future Road-Surface Design

By Edward L. Viets
Sales Manager, The Service Recorder Co., Cleveland

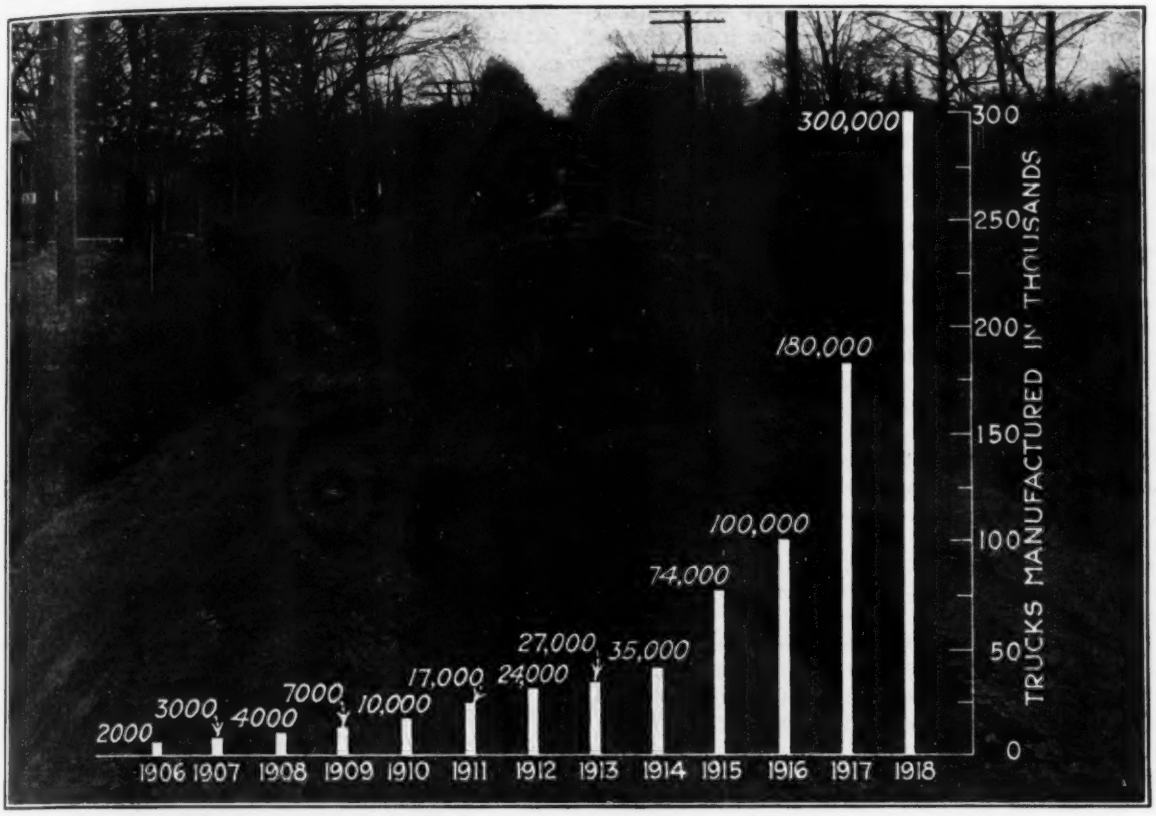
ROADS, tires and economy are the factors which will determine the design of the road surfaces of the future, and not the possible size of motor trucks. Motor trucks of 100-ton capacity are mechanically possible, but how to build the roads, how to design the tires, how to operate economically—in any but a few cases—large-capacity trucks, are problems not so easily solved; in fact, they are practically unsolvable. With these facts admitted, it should now be possible, and it is the urgent need of the hour, to establish what is the reasonable working load for commercial motor transportation.

The road builders of the world are face to face with a new problem. Briefly, it is this—how to protect the hundreds of thousands of miles of roads which have been years, decades, even centuries in the building, from the tremendous wear and tear of a new vehicle which has made its appearance in great numbers only since 1912.

The roads which were built in the days of Rome served the modern traffic of the year 1900 and served it well, for in the eighteen centuries, more or less, which had elapsed since these roads were built by ancient masters of the art, no essential change in the construction or the weight of road vehicles had taken place. How has it been since 1900? First, the automobile made its appearance, and the numbers of this type of vehicle increased in a few years from a handful to many millions. Vehicle speed had suddenly been increased from the three to eight miles an hour of the horse to the 15 to 40 or even 50 or 60 miles an hour of the gasoline motor car.

Problems Solved and Unsolved

Consternation filled the minds of the road builders, because this new vehicle began to destroy even the best of the macadamized highways of the day. Soon, however, it was found that if a suitable binder were provided for the surface of roads—tar instead of water—this new vehicle could be rendered quite harmless. For its weight was not excessive, it rested on the road with broad, soft, air-filled tires, and it had previously worked its destruction only because of its speed and the clinging quality of its rubber tires, which whirled away road surfaces in a fine dust. It was well for the roads that this simple expedient was discovered, for this new vehicle descended upon them like swarms of locusts, suddenly and almost without warning.



EXPANSION OF MOTOR-TRUCK INDUSTRY IN ANNUAL OUTPUT, AND EFFECT UPON LIGHTLY CONSTRUCTED ROADS

This problem having been luckily solved, a new one appears—the motor truck. This new vehicle approaches with less speed than the passenger automobile, but it seems more formidable. It plods along with its heavy artillery wheels, its solid tires and its strong axles. It does not flit by in a cloud of dust; it does not merely disturb the surface of the road; instead, it shakes the earth. More than tar applied to the surface of the road is required to withstand the rolling of this vehicle. It requires a new foundation, heavier and stronger than any used before. And that means a new road, reconstructed from the foundation up.

As a result of this comparatively recent motor-truck traffic, many roads which were previously thought perfect have suffered serious damage. Such an instance, together with the cause, is shown in one of the illustrations. Present road conditions are probably much worse than the average person would believe possible. Highways connecting important cities are in many cases broken down or have stretches which are well-nigh impassable. News items such as the following, taken from a Cleveland paper under date of Oct. 2, are frequently read:

"Overland driving of Government trucks and creation of intercity motor-trucking systems are creating a problem greater than that of building roads to make such driving possible. It is the maintenance of the roads already built."

Even our crack highways have in certain cases broken down, as this note indicates:

"The Lincoln Highway across Pennsylvania, up to the time truck trains began to use it, was a veritable boulevard of macadam, and the pride of the commonwealth. It is rapidly disintegrating."

These facts have an ominous sound, for if some of our best highways are giving way under the strain of truck travel, what will become of our poorer roads, more numerous by far, and also used by motor trucks? And what will become of all of our roads, if motor trucks, which have increased from 60,000 in 1912 to 600,000 in 1918, pass the million mark next year and the two-million mark within the next three or five years?

The highway engineer of the present time is facing as big a problem as that which any public servant is grappling with. It is not only big, but it is urgent. It is not only urgent, but it is difficult. It seems, in fact, in many of its phases, unsolvable. But it must be solved, for the motor truck has proved itself to be a second railroad, and it promises to become one of the most important agencies of transportation of the near future. Its growth in the past five years of its existence has been more rapid than the fastest pace of railroad expansion, and, with roads leading everywhere, it may even outstrip the railroad in ton-mileage hauled yearly. The highway engineer recognizes the importance of motor-truck transportation, and has set himself the task of making highways which will carry trucks, and carry them all the year round. But do we in turn recognize the problem of the highway engineer?

Here are some of the difficulties of the road builder's problem—difficulties so numerous that the space avail-

able is sufficient only to list them and not to discuss them: What is the effect of trucks on road surfaces? on road foundations? What is the effect of speed? of weight per inch of tire width? of total wheel weight? of steel tires? of solid rubber tires? of pneumatic tires? of tires with flat tread? of tires with rounded tread? of solid tires of comparatively high section? of solid tires which are nearly worn out? What is the effect of trucks driven electrically? of trucks employing a four-wheel drive? What is the effect of density of traffic? (Take, for instance, the section of the Lincoln Highway referred to above; it is not likely that the first few hundreds of trucks driven over it caused much damage, but when thousands of motor trucks came, the highway broke down under the repeated blows.)

Let us assume that the road builder is able to judge the probable effect of density of truck traffic; then he must turn prophet and estimate what the future traffic is likely to be. But, you ask, why is it necessary to figure so closely? Why cannot the road builder lay down roads which will stand up under any kind of traffic, practically for an indefinite time? That brings us to another difficulty—the ever-present problem of expense.

There is no public work which compares with road building for absorbing the nation's money. The roads of the country count some two million miles, or, roughly, seven times the total railroad mileage of the nation. To build a modern highway, one with a foundation which will stand a vehicle weight of 15 or 20 tons, costs at least half as much per mile as the average expense of constructing a mile of railroad track. The Lincoln Highway is 3333 miles in length. This is not much in comparison with the two million and more road miles of the country; yet the construction of this highway was not to be undertaken in a holiday spirit. Work has been under way on it for three years; the highway is not completed; but a section of it which was constructed through a wealthy state, and without attempt to economize in materials and labor, broke down under the traffic of Army trucks—numerous, it is true, but none of them larger than five tons in capacity and many of them three-ton trucks or smaller.

Highways a National Problem

No attempt is here made to underestimate the work of those farsighted men who are building magnificent highways across the country. They are the Romans of the present day, and their work will be fruitful in producing lesser but more numerous highways which will spring up and intersect the great roads. But it is necessary to count the cost. To make permanent highways of the two million-odd miles of roads of the country would cost many times more than the construction of the Panama Canal. Of course, it is not necessary to improve all the roads of the nation in this way, but to modernize even a tenth of this mileage is a task not to be attempted by states, and not to be completed by the national Government inside of a dozen years.

So the seriousness of the problem becomes apparent. On the one hand a new kind of traffic, growing prodigiously and at an increasing rate, and throwing an enormous weight of tonnage on our roads; on the other hand a sum of money available which is large, but not nearly large enough to make roads suitable to carry this new traffic. The road builder, though he appreciates the economic importance of this new transportation, cannot satisfy its demands entirely. He is in the position of a man trying to live on an insufficient income, and must act accordingly. He must spend his money on certain roads and neglect others, or he must improve all his roads, but not up to the standard required by the new traffic. Who is to blame? Nobody. The situation is one produced by circumstances, and it cannot be overcome by mere policy or cleverness. We have with us a new system of transportation which promises to be as important as the railroad, but, if we utilize it, it will be necessary to make a roadbed for it.

What Will Future Truck Be Like?

But the greatest perplexity which confronts the road builder is yet to be stated. It is this: What will the motor trucks of the future be like? When we lay the foundation for a building, we must know the weight of the building to be supported. If extra stories are to be added later, provision must be made by constructing foundations of greater strength.

Now we are approaching the time—in fact, it is already here—when roads are made of masonry. Foundations 6, 8, or even 10 in. thick are being laid. These are meant to be permanent, or at any rate to last for an indefinite period. Unlike the old dirt or clay road, the modern highway, when broken down, cannot be repaired except at great expense. Suppose that after millions of dollars had been spent in constructing roads suitable for the present traffic, a new kind of motor truck should be built, weighing 20 or 30 tons when loaded, and capable of destroying in a short time even the best highways!

The importance of this question, if measured in money, may be said to represent many millions of dollars. Can it be answered? Shall we find ourselves, ten years from now, in possession of an enormously expensive system of roads which is obsolete and which will have to be rebuilt? Or shall we be able to plan today for the traffic of the future, and thus avoid a useless expenditure of public funds?

The writer does not pretend to be able to answer this question. It seems almost enough to state the question and to call attention to the fact that those who make roads and those who make vehicles must get together on this matter. In the meantime there are certain indications, which may be worthy of notice, pointing to an apparent limitation in the further increase of truck size.

Five-Ton Rating Seems Definitely Established

First, let us examine the vehicle itself. A recent list of the models turned out by more than 100 active motor-truck manufacturers shows that 47 different makers build trucks up to and including 5 tons in capacity. Only six make trucks rated to carry a heavier load than 5 tons. It will be of assistance in working out this problem to consider the 5-ton rating as a kind of dead-line beyond which truck makers hesitate for the present to step. Some of them have stepped over it, it is true, but in the past few years seven or eight have stepped back. The 5-ton rating, on the other hand,

seems to have been definitely established, for nearly half of all the active truck manufacturers build models up to that capacity.

But this is only an indication and not a law. Road builders, who in a few years can easily spend billions of dollars on new roads, require a more definite assurance. They know, for instance—or they should know—that one of the prime reasons why heavier trucks have not proved more popular has been the condition of the roads themselves, and that as soon as roads are improved there is a possibility that truck sizes will be increased, so that the race may go on again as merrily as ever, with the truck always a little ahead of the road, and the road struggling to keep up with the truck.

Physical Limitations of Truck Size

Why not put the case bluntly: "Is there any physical limitation to a further increase in the size or carrying capacity of motor trucks? We are about to lay down permanent foundations for them, and that is why we want to know."

The truck makers have replied in substance as follows: "So far as the truck itself is concerned, there is no engineering difficulty involved in increasing its carrying capacity almost indefinitely. We feel quite satisfied that the engineers of this country could eventually design and build trucks of 100 tons capacity, provided they were able to get roads and tires which would stand up under them."

What should limit them? Springs? Freight cars of 50 tons capacity are supported by springs. Wheels? They could be made of steel. Frames? They can be made enormously strong. Engines? An engine of 40 hp. is sufficient to operate a 5-ton truck—they are already putting engines of 200 and 300 hp. in airplanes. Axles? The 200-ton locomotive has axles also. Steering? That could be done by power if necessary.

Tires?

Yes!

And here you have a real limitation, and one which, so far as we can see at present, prevents the further excessive increase in truck size as absolutely as would a Federal law to that effect. There is a natural limit to the strength of rubber. Place a certain weight upon a rubber tire and it will yield without damage to itself. Increase that weight beyond a certain point, and the rubber breaks down. It breaks down completely and is ruined.

Manufacturers Agree on Tire Loads

What is that limit? It cannot be stated definitely in ounces or even in pounds. Manufactured rubber is a thing so compounded and made up of so many ingredients that the products vary enormously in their physical properties. The rubber chemist is like a cook with a thousand recipes at his disposal. Pure rubber is his basic material, but he gives it strength, or elasticity, or toughness, or hardness, according to the different elements which he combines with it.

But the question is academic. We do not need to have it answered. Far more pertinent to our problem is this: What is the limit to the strength of that kind of rubber which the rubber experts (the tire manufacturers), after a dozen years of experimentation, have found most suitable for truck tires?

Fortunately, the doctors have pretty nearly agreed on this point, and the schedule of carrying capacities shown in the table, issued by one large tire-manufacturing company, is practically the same as that subscribed to by all the tire companies. Moreover, these weights have stood practically unaltered for several years. But here again we are not interested in the exact poundage allowed by the different manufacturers. This is more largely a matter of guesswork than the average tire user thinks.

MAXIMUM LOAD CAPACITIES FOR SOLID TRUCK TIRES

Single		*Dual*	
Width, in.	Maximum Load, lb.	Width, in.	Maximum Load, lb.
3	1,000	3	2,000
3½	1,300	3½	2,600
4	1,700	4	3,400
5	2,500	5	5,000
6	3,300	6	6,600
7	4,200	7	8,400
8	5,200	Dual tires	
10	7,000	impracticable	
12	8,800	beyond this size.	
14	10,600		

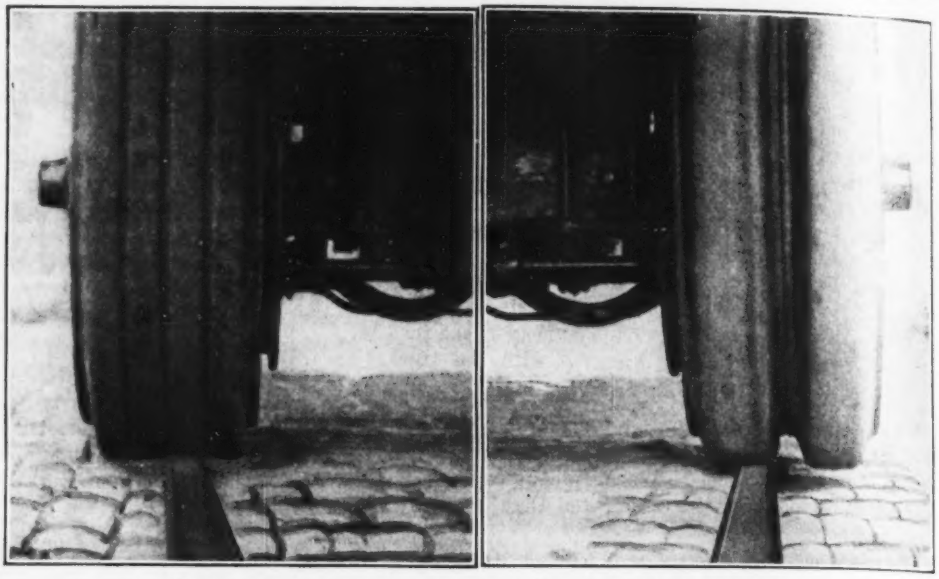
Uncertainties of Tire Strain

I do not mean by this that the processes inside the tire factory are irregular or the results obtained uncertain. The reverse is true, and the tire manufacturer is able by means of delicate instruments to "measure" the properties of his finished products to a nicety. The "guesswork," if we may so term it, comes when the tire is sent out for service. What carrying capacity shall the tire maker fix upon as the maximum which his tire shall bear? If roads were as level as bowling alleys, the tire maker could use his laboratory experience to good advantage. But such is not the case. Here is a 7-in. tire, let us say, which, when bearing on a flat surface, is capable of sustaining without injury so many thousand pounds. But after this 7-in. tire is fitted to a truck wheel, what happens? Perhaps on a boulevard the tire rests with its full width on the ground; but here is a sharply crowned road where only half of the tire bears; here is a rocky road where the broad tire passes over the tops of protruding stones; here the truck crosses a raised track, or runs lengthwise of it, as illustrated (see next page) and the tire may bear for the moment with only one-seventh of its tread supported.

Nobody can prophesy in advance what strains a truck tire will be called upon to stand; hence, after the tire maker has constructed his tire with all the aid which science can give him, after he knows what load his tire could safely support if all the streets were absolutely level—then he must close his eyes and guess what additional strains the tire is likely to encounter and provide a factor of safety to take care of them. That this can only be guesswork is proved by the astonishing variance in the performance of tires made by the same company. Some run as high as 40,000 miles, some 20,000 miles, some fail at 5000, some go to pieces in less than 1000 miles. This can only be accounted for by the great variance in the stresses which different tires encounter in service, for, concerning the tires themselves, they are made with such scientific accuracy, in so far as ingredients and cure are involved, that they come out of the oven practically identical products.

Now, while this explanation is necessary to show the true significance of truck-tire carrying capacities, it

is essential to note that, for the purposes of the present problem, we do not need to know how the tire makers arrive at their tire weight limits. The important point to grasp is, such limits do exist, and they are so restricted that it is entirely possible that the progress of motor-truck construction has already reached a point where these limits forbid further increase in truck weights. This is stated as a fact rather than an evil, for perhaps it will, in the long run, prove to be a benefit.



TIRES HAVE UNEQUAL BEARING ON IRREGULAR SURFACES

To make this point still clearer, consider for a moment the steel tire such as is used on wagons. It is true that a small wagon has narrow steel tires, and a large wagon has wider steel tires, but this is largely a matter of wheel strength, and so far as the strength of the steel tire itself is concerned, it is probable that a steel tire an inch wide would support the heaviest wagon it is possible to build. In other words, although even steel tires have their limits, these limits are so distant that they would probably never operate to prevent the growth of vehicle sizes. Rubber, on the other hand, is much more limited in strength, and its limits are such that they are always a matter of concern to the truck builder.

Steel Tires Impracticable for Motor Trucks

However, the use of steel tires on motor trucks is quite out of the question. Not only is it impossible to build trucks which would stand the terrific pounding of the road against steel tires, but if such tires were used they would destroy the roads so fast that legislators everywhere would take steps to limit the use of them, as they already have done in several states in this country, as well as in France and England. This matter comes up particularly in the use of the trailer, which, of course, in many cases could be equipped with steel tires without straining or injuring the motor truck which hauls it. This is a case where the only argument against the use of steel tires is that having reference to the preservation of the roads; but this argument is all-sufficient when the great destructiveness of heavy trailers equipped with steel tires is considered. Not long ago one trailer equipped with steel tires and hauling 5 or 6 tons broke through and destroyed several hundred yards of granite-block pavement in New York City. Such destruction, of course, is entirely out of proportion to any economy to be derived by the use of steel instead of rubber tires, and trailer manufacturers themselves have been among the first to realize this.

But, it may be said, if a 4-in. rubber tire is stronger than a 3-in., a 5-in. stronger than a 4-in.—if, in other words, tire strength is proportional to tire width—why is it not possible by building wider tires to increase tire strength indefinitely? The answer is important. The excessive strains due to uneven bearing, occasionally present in the case of small tires 3 or 4 in. in tread width, increase as tires are made broader, and they increase out of proportion to the increase in tire width, becoming a very serious factor in tires 10 in. wide or more, and practically prohibiting the construction of rubber tires of greater width than 15 inches.

To get a clearer idea of the unequal bearing of the tires on crowned streets, let us consider a 16-in. width of tire on a street having a crown of ½ in. to the foot. To get any bearing at all at the outer edge of this tire, the inner edge must be compressed about ¾ in. On a tire 2 ft. wide, the compression necessary would be 1 in. Such a condition would rapidly wear the inner edge of the tire, if it did not destroy it outright by exceeding the elastic limit at the first operation. With an indefinite increase in the width, it is evident that a large part of the wide tire would soon be hanging in the air.

No Manufacturing Limit to Tire Size

This exaggerated example shows clearly the limitation which prevents the indefinite increase in tire sizes. The difficulty is not in chemistry. The wonderful tire builders of Akron, and those who, learning from Akron, have gone to other parts of the country to build tires, may be expected to solve any problem which relates to the chemical construction of truck tires. It has been said that insurmountable difficulties have been encountered in the curing of wide tires. It is true that the difficulties have been encountered, and also that they have been overcome. But that is not the reason why the width of solid rubber tires is approaching a limit. For that matter, if such a difficulty did exist, it could be overcome by putting three, four, or five small tires side by side on a single wheel.

We find, then, that the condition of our roads and the probable limitation in the size and strength of

rubber tires have tended and probably will tend to limit the weight of the motor trucks of the future. There is another consideration, fully as important. Let us state it briefly:

A dry-goods house owns five 1-ton trucks. They cost $10,000. Each truck needs a driver, perhaps a helper, garage space, care, etc. For $5000 this store could buy one 5-ton truck, employ one driver and helper, cut down expenses in other ways, and yet get the same load-carrying capacity. Why is this not done?

The reason is obvious. The big truck in this case would fail to give service. And not only that, it would probably take four or five days to deliver the parcels which five 1-ton trucks deliver in one day, and thus it would cost more in dollars and cents to deliver these goods with one unit than with five.

Here we have another satisfying factor which tends to limit the size of motor trucks. In any line of business where several stops have to be made in delivering goods, there comes a point where increasing the size—and hence the expense—of the carrier becomes unprofitable. Past experience has shown that this limit is under 5 tons.

An Alternative for the Large Truck

How about the man who hauls sand? How about the man who hauls asphalt? brick? almost any material used in contracting or building? He makes only one stop; it is to his interest to carry as much at a time as he can. The 5-ton truck, the 7-ton truck, even the 10-ton truck could be used profitably in such work, if it were not for the consideration of tires and roads. But these considerations do exist; one of them touches his own pocket-book, and the other will increasingly touch his civic conscience, or be made a matter of Federal regulation.

But here again there is a way out. It is concentrated weight, not distributed weight, which breaks down our roads. If a man has 10 tons to carry, let him put it in two carts instead of one, and the road will benefit by it. In other words, the trailer will provide the outlet for the future increase in truck loads. And, singularly enough, it is precisely in such kind of hauling, where there are heavy loads and few stops to be made, that the trailer works to best advantage.

Roads, tires, economy—these three factors, rather than any limitation in the art which American engineers use in building trucks of steel—are what prevent and will continue to prevent any great increase in the size of the motor trucks of the future. Nobody is blind today to the enormous utility of the motor truck. Nobody is going to try to legislate it off the earth, unless it be the road commissioner of Country Corners, or the sheriff of Buttermilk County. Prejudice has died away, and in its place has come a country-wide realization of what people only barely realized when they saw the first passenger trains steaming across the country. Highway transportation of freight is here, and it may outstrip highway passenger transportation—the automobile—soon.

But a great problem remains to be solved. A vast system of roads is about to be brought into being. Call them foundations, rather, instead of roads. If these foundations are too weak, or if these foundations, strong enough for today, are not strong enough for tomorrow, then billions of dollars will have been thrown away. As a general precept, roads should be built to stand the accepted traffic of the day. But we should be ready at this time to determine what this standard traffic is. We should distinguish between what is typical and what is freakish, and establish our maximum weight without hesitation. Roads are like bridges—especially modern roads—in that when they break down they break down entirely. The road builders have to know what weights these roads shall bear. They require an answer which will serve for several years. And, even more than a correct answer, they must have a definite answer. If they receive it, they will spend *our* money to better advantage.

Highways and Truck Loads They Can Economically Sustain

By H. Eltinge Breed
First Deputy Commissioner of Highways, New York State

MOTOR-TRUCK traffic is limited by the number of miles of highway able to sustain it. The motor truck marks a distinct transition in transportation facilities. It has made the highway as available for freight haulage as were previously the waterway and the railway. The service of the motor truck in the freight crisis of the past year established forever the importance of the highway as an integral part of the transportation system of this country. The modern vehicle is a magnificent tool for furthering the prosperity of the era before us. But so far it has been fatal to the very factor upon which its usefulness depends—it is the greatest destructive force the highway has ever encountered. Until we harmonize the "tool" and the "way," we shall secure no permanently satisfactory results. It is the object of this paper to show the reaction of various types of pavement to motor-truck traffic, and to make suggestions for the future.

Macadam Unsuitable for Motor-Truck Traffic

Our greatest mileage of improved roads is in water-bound macadam. We build it with a 6- to 9-in. stone sub-base bottom course, and a 3-in. top course, giving a road from 9 to 12 in. in thickness. In soft, unstable soil, additional sub-base is used, so that in some cases the depth is increased to 2 ft. or more. The surface must be waterproofed, and constant maintenance is required to keep it in good condition. The cost of maintenance on this pavement is $600 to $1200 a mile each year. For the past five years, the writer has had under observation a large mileage of this type. The results have been so uniform as to leave no doubt of the conclusion that water-bound macadam roads of our strongest present design will not sustain motor-truck traffic. In every case, as the traffic increased the pavement disintegrated and in times of unstable soil broke up. Of course, at additional expense we can redesign for greater thickness, but the wear on the crust and the abrasive action on the pavement would still be as great, so that at best we should obtain a road almost as high in first cost as a road of one of the permanent types, with maintenance charges six times as heavy, and with the additional necessity of frequently rebuilding the top course under the handicap of heavy traffic.

Bituminous macadam is in much the same class as the water-bound. Its surface is waterproofed. Due to the use of a binder, it has greater cohesion of the crust. It is higher in first cost than the water-bound, but not quite so costly to maintain. Good results in wearing qualities can be procured in it only by closest attention to such details as the selection of material, the assurance of uniform thickness through a smooth base, and insistence upon doing work at the proper season. Bituminous macadam has not shown up favorably under the heavy traffic of the past two years. This pavement, also at greater first cost, can be thickened to stand heavy traffic better, but as it would still have a higher maintenance cost than the durable types of pavement, its building would not be economical where there was any prospect of much motor-truck transportation.

More Durable Types of Pavement

These two are semi-durable types. Among the more durable types of pavement are included brick, concrete, granite-block, wood-block, asphalt-block and the asphaltic mixed type on concrete foundation. These pavements are more permanent because their crust is rigid as well as cohesive, and, therefore, unless broken through, it carries the load as a slab, a beam, or a cantilever.

The brick pavement has endured heavy traffic well. At least, the brick pavement of monolithic form has, where the brick form an integral part of the pavement by being placed on either a foundation of green concrete, or in a mortar cushion of cement and sand. Brick pavements with only a plain sand cushion have less claim to durability. The vibration from the impact of heavy motor traffic rapidly displaces the sand, the brick shift, depressions occur in the surface, and the pavement goes to pieces.

To secure greater resistance in brick pavements than any examples of it have yet shown, the brick should be selected and laid with respect to their hardness, i.e., brick of varying degrees of hardness should not be placed next to each other. Where the hard, brittle brick is laid alongside the soft and tough brick you get unequal wear.

Much better brick pavements could be secured if the brick manufacturer would select and sort his product according to the varying degrees of hardness, so that those within certain limits could be laid together. I do not believe that we shall get the best results from our brick pavement under heavy traffic until this is done.

Asphaltic Pavements Are Less Noisy

Asphaltic-concrete, sheet-asphalt and asphalt-block pavements have the advantage of being quieter than brick or concrete. This is due to the resilience of the surfacing material, which has drawbacks as well as advantages. Unless a proper selection and incorporation of the materials in the binder is made, and unless the binder is stiff enough, heavy, concentrated traffic is apt to cause further consolidation and wrinkle up the pavement. Action by impact is accelerated, and the day hastened when the pavement has to be rebuilt.

In granite-block pavement, smoothness of surface is desirable. The writer believes that this type should be laid with a cement-grout filler, to gain increased strength and smoothness. All these types require a strong concrete foundation of thickness approximating that for a concrete pavement and where they have been built in accordance with the above conditions they have have invariably given us good service under heavy traffic.

Concrete Pavement Has Lower First Cost

The great advantage that the concrete pavement has over them all is its lower first cost. While this statement is general, certain particular cases have proved the exception to the rule.

When I speak of concrete types of pavements here, I refer to concrete of the 1:1½:3 mix. The writer has had more than 300 miles of this type of pavement under observation for the past three years—some of it for a longer period. It has most satisfactorily carried the new traffic, without any failures due to the amount and the class of traffic upon it. It has shown one weakness that can easily be corrected, i.e., the cracking through of the corner of the slab, which is caused by the pounding due to impact and the unstable soil under the slab. The unevenness or the rise of one slab above another increases this action by impact, and by some it is cited as an argument against the use of joints. The writer believes that these joints are necessary to provide for expansion, a lack of which would allow the internal stresses to injure the structure of the pavement in such manner that there would be early disintegration. However, the few slabs that have broken at the corner points are still performing their full service without disturbance to traffic.

Concrete is the cheapest of the durable types of pavement. While its first cost is higher than that of either of the semi-durable types, its low maintenance makes its total cost at five years of age considerably less than theirs. Less than $100 per mile per year keeps it in repair.

By the application of the principles of mechanics, and figuring the corner of the slab as a cantilever, unsupported by soil directly beneath it, and with an allowance of 50% for impact, we find that a thickness of pavement of 8 or 9 in. gives a reasonable degree of surety that it will sustain motor trucks weighing 14 tons including load. It seems desirable, therefore, that we build our concrete pavements on an average of 8½ in. in thickness. High-speed traffic and the use of very wide motor-truck bodies makes it imperative that the road shall be 20 ft. wide, in order that vehicles may pass each other with safety. This would make our pavements 7 in. thick at the sides and 10 in. at the center. Width affects strength, greater thickness being required for greater width. Greater center thickness, compared with the thickness at the edge, can be obtained by dishing the subgrade, if desirable.

Great care must be used in the selection of the aggregates and in the workmanship on the concrete pavement, in order to secure uniformity in results. The smoothness of the surface is especially important, as imperfections in it increase the impact from the passing load.

Those are some of the things that we know about the highway in its relation to motor-truck traffic. Here

are some of the things we don't know; they are the variables in our problem for which we have to assume constants. The greater the number of assumptions, the greater are the chances of guessing wrong and building a pavement doomed to destruction. To meet the demands of motor-truck traffic, highway engineers must aim to develop their art from an empirical into an accurate science.

Some of the troublesome variables are: Cohesion of crust, bearing power of soil, smoothness of pavement, inequalities of pavement structure, lack of uniformity in the aggregates, moisture, and frost. How strong is a given thickness of crust? What is its cohesion, and what changes has it suffered between the passing of truck No. 1, and the passing of truck No. 100? We can gage the action of the wet and frost, but we cannot determine it, because it is complicated by factors in the load. Cohesion of crust and stability of soil are affected partly by vibration of wheel; which, in turn, is influenced by smoothness of tire and pavement. An overload causes greater compaction. The impact from the hammer blows of certain loads and tires upon the pavement crust exerts a pumping action which draws up water whenever the subsoil is wet. Impact depends upon springs, tires (pneumatic, cushion, solid or steel) and speed. Effect of load depends upon width of tire. Abrasive action depends upon the condition of the tires and the presence or absence of chains. The problem is an involved one.

Learning From Former Success

Now, I would make two points for future practice: First, admitting freely the undetermined factors, let us learn henceforth from our successes, as we have learned heretofore from our failures. We know now that certain types of pavement have proved equal to the heaviest traffic we have. Then let us go ahead and build those types without further palavering, and let us learn from observation of their endurance to supply the unknown quantities in our equation. The demands of traffic are upon us. We have lagged behind since 1902. For the sake of national prosperity, we can't afford to lag behind any longer; we can't afford to squander wealth and energy upon experimentation with unsatisfactory types. Let us take the sure thing. If success teaches us to devise something still better, good!

Second, we must definitely eliminate our worst unknown factor—the weight of the load. For the past 15 years we have built roads that have attracted to themselves traffic far greater than they were designed to bear, to the alarming depreciation of the investment in the road. The faster we build roads, and the better, the greater and heavier will be the traffic put upon them, until thousands of miles are destroyed and millions of dollars lost. Only within the past year have we in New York State caught up with the demands of the passenger car for completed through routes, and now the truck is upon us, and roads designed for three tons are having twenty put upon them. They are going to pieces. Five millions a year are being spent in repairs, where at least half of it should be going for new construction. The thing is inevitable until we agree upon some arbitrary limit of load for which we are to design the highways.

It was exactly the same with the railroads, the track and the engine forever outstripping each other with enormous economic loss, untill an arbitrary limit of load and speed was determined upon. Increases upon it since then have had to be of proved economy from the point of view of considering both the "tool" and the "way." In any system of transportation, those two must be reconciled before we can derive full benefit.

Look at our latest traffic reports on 15 highways in various parts of New York State. There is an increase in truck tonnage varying biennially from 50 to 400% and an average increase of 150% over the tonnage of 1916. To try to build highways in pace with a continuous advance of that kind would bankrupt the public.

Five-Ton Load Should Be Established by Law

The wiser motor-truck manufacturers have themselves adopted the broad policy of selling transportation service, rather than the exclusive one of selling motor trucks. These men, who have had every opportunity to study the economics of the problem, have agreed upon the desirability of the 5-ton load as a standard unit. This should now be established by law, and our highways designed to meet it. It will mean a total maximum load of about 12½ tons, of which approximately nine shall be applied to the rear axle. There should also be general regulations for other destructive factors, such as inadequate tires and springs.

We can build roads economically for the 5-ton load. We cannot afford to have them disrupted by a few excessively large trucks. Nor should we design them extravagantly to meet the requirements of a few individuals. The maximum loading must be restricted to the economic standard suggested by the manufacturers and desired by the big majority of truck users. Then will the highway be able to give to the motor and to the community its most efficient service.

Purchase Meters on Percentage Accuracy Above Ninety Per Cent.

Latest specifications for accuracy of six water-measuring devices, for installation in the Mayfair and 22nd St. pumping stations, Chicago, differ from those under which previous pitometers have been purchased in that the "marking" of the proposals for accuracy will be given "O" for 90% accuracy and a full mark for 100% accuracy. Formerly it was the practice to rate the bidders 90, 93 or 98%, as the case might be, giving the 90% machine an undue advantage when, as a matter of fact, such a machine would not receive consideration at all.

In marking the item of price, the lowest bidder receives the full mark, others in inverse proportion. Workmanship and dependability are judged by a committee of competent engineers, appointed by the commissioners of public works, who may make any tests determined upon by them to aid in reaching their conclusions.

The contract is awarded to the bidder obtaining the highest mark based on the following schedule: Price, 10%; accuracy of pitometer rod, 40%; accuracy of recorder, 25%; workmanship pitometer rod, 5%; workmanship recorder, 5%; dependability of recorder, 15 per cent.

Great Lakes Yards Lead Coast Districts in Building Ocean-Going Ships

Produce Canal-Size Steamers in Large Numbers—Spirit of Coöperation—Yard Capacity Doubled—Side Launching—No Outside Fabrication—Equipment of Varied Character—Labor Shortage

(Passed by the Publication Approval Committee, Emergency Fleet Corporation)

MORE than half the steel ships delivered to the United States Government in July, August, September and October, amounting to more than one-third the total in tonnage, were built in Great Lakes shipyards. The Lakes, District 9 of the Emergency Fleet Corporation, are at present the leading shipbuilding district in the country. They are doing their work with old yard layouts, old equipment and old methods, without help through bridge-shop fabrication or simplification of ship design. They are handicapped by inadequate steel supply, by constant draining away of the labor force on the part of other districts and by the limitation of size which arises from the necessity of locking the ships through the Welland and St. Lawrence Canals—a large vessel can be built more rapidly than a small one, in proportion to tonnage.

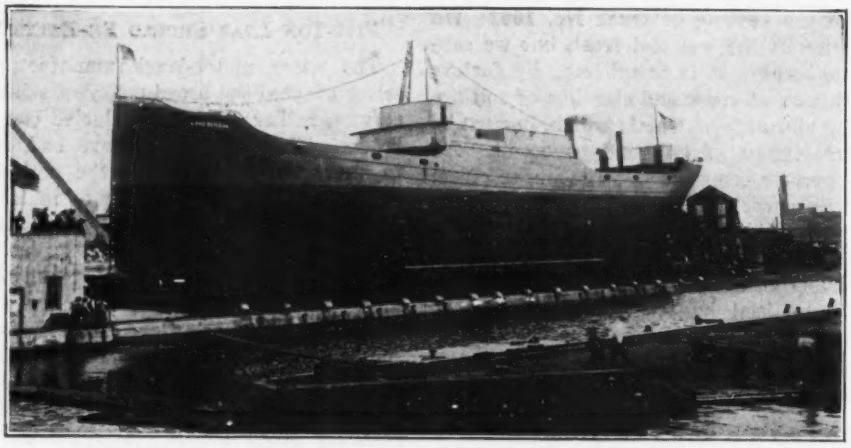


FIG. 1. SOME OF THE GREAT LAKES YARDS LAUNCH INTO DRY DOCKS—BERTH FITTED UP ALONGSIDE NEW SOUTH CHICAGO DRY DOCK

Not only are they building ships in quantity, but they are building them cheaply. Fleet Corporation officials state that very low costs are being made in the Lakes yards, though hours and wages are the same as in other districts. The highest riveting averages in the country are being made in District 9. For some time past the district as a whole has averaged nearly 400 rivets driven per gang per eight-hour day, and some yards are reporting 450 to 500 rivets per gang regularly, week after week.

Distinctive shipbuilding methods and equipment, which were developed during many years of lake steamer building, are used. They have been applied with surprising adaptability to the new class of work now demanded. But efficient management and a remarkable spirit of coöperation are prominent factors in the Great Lakes production.

Coöperation is the newest and most noteworthy force at work in the district. Under the direction of Henry Penton, district manager for the Emergency Fleet Corporation, the yards are working as a single organization. One manager said, "There is no more rivalry among the Lakes yards. We all help one another as much as we can." In place of aggressive commercial competition there is friendly rivalry for best performance. The Great Lakes Shipbuilders' Association, formed as part of the coöperation machinery, furnished means for standardization such as uniting on two designs of ship and a single design of engine, and has brought about exchange of drawings and essential information. That the Lakes yards are managed efficiently was emphasized strikingly by several noteworthy speed performances in building ships. The Lorain and the Manitowoc yards each built a ship in 24 working days, keel-laying to launching. The Ecorse yard surpassed both of them and established a world's record by launching a ship 14 working days after its keel was laid, and then showed that it had further reserve of speed by completing the vessel in 15 working days more. The record ship, the "Crawl Keys," steamed away on its trip to the sea on the thirty-fourth calender day from the time the first piece of steel was laid on the keel blocks.

Steady pace of production also testifies to the capable management of the yards. Figures from one group of six yards are significant: In the hottest week of the past summer these yards drove 600,000 rivets, as against their maximum week's output in good weather of 718,000; only 16% drop-off was caused by the heat, though temperatures exceeding 100° prevailed for several days.

A prominent case of remarkable regularity of production is furnished by the Wyandotte yard, a yard building only hulls, which are equipped at Detroit. A graphical record of keel-layings, launchings and completions for this yard since the beginning of the war-time shipbuilding two years ago is shown in the diagram, Fig. 2. The curves prove a steadiness in production rate comparable to that of a smoothly working factory. Yet during the time covered by the curves the yard was almost wholly rebuilt and was enlarged to two and one-half times its former size. Throughout the whole period, moreover, the yard's efficiency was improving; the time required from keel-laying to launching was reduced in two years from 120 days to 75, and the total time from keel-laying to completion reduced from 190 days to 95. Further-

more, shipbuilding was not interrupted or delayed by winter conditions. In the winter of 1916-1917 the curve of completions flattened off, though the launching curve showed little disturbance; but in the following winter both curves maintained their slope most remarkably, in spite of exceptionally severe weather.

Four of the lakes share in the emergency shipbuilding, with yards scattered from Buffalo to Duluth. As listed in the accompanying table, their total equipment now comprises 81 building berths for the 261-ft. steamers of the Emergency Fleet Corporation. Expansion has been in progress from the start. Previously, all the yards were laid out for building large lake steamers; one berth of the old type could be utilized for two berths of the size now required, but even so, the number of berths was far from adequate. Some of the new berths are still uncompleted, but they will be ready for work well before winter. Three new yards were put in service, Saginaw, Globe and McDougall. Even deducting these, however, the district has nearly doubled its capacity, and practically all of this increase is the work of the past year, done while shipbuilding was kept up at full speed.

At the beginning of November outstanding contracts for ships totaled 285 vessels. All these are expected to be completed before the close of navigation in 1919.

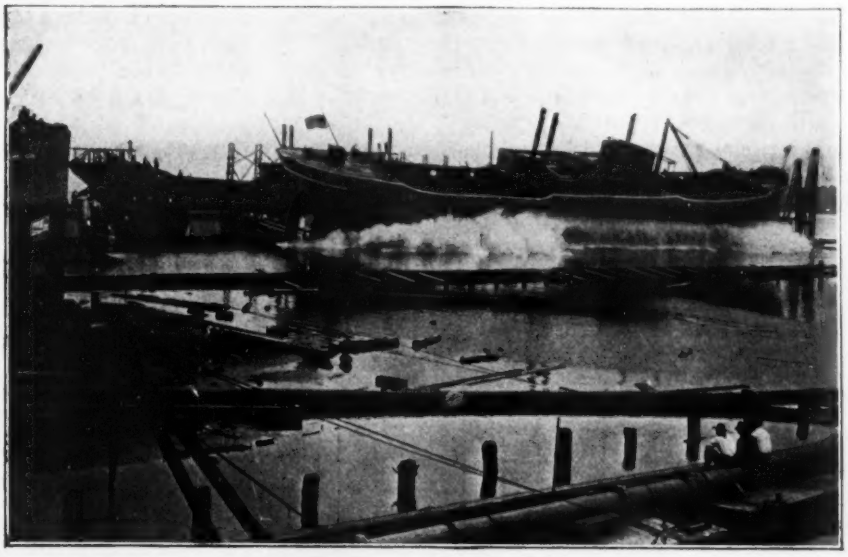


FIG. 3. SHIPBUILDING AND YARD GROWTH—IN FOREGROUND NEW PIER FOR FOUR ADDITIONAL BERTHS AT DULUTH YARD UNDER CONSTRUCTION

Tugs are being built at a number of small yards. These do not affect the main cargo-carrier work, but they increase the activity of the district and add to its problems of material and labor supply. Practically all of these are new enterprises. They have orders for 51 sea-going tugs 150 ft. long (38 steel and 13 wood), and 41 harbor tugs 100 ft. long (2 steel and 39 wood). In addition to these yards there is one at Buffalo, also a new enterprise, where barges are being built for the Railroad Administration, besides three concrete barge yards.

Except the last-named, all the work is for the Emergency Fleet Corporation, which has absorbed the entire shipbuilding capacity of the Lakes. The whole capacity is being applied to constructing ocean-going vessels. No additions are being made to the Great Lakes carrier fleet. On the contrary, its ships are being taken one by one, rebuilt and cut in two for passage through the canal, and sent to sea. Most of the shipyard dry docks are busy with this work.

Twenty-five or thirty large vessels were taken from the Great Lakes in this way during the past two years, and anxiety has been expressed by men familiar with conditions as to the depletion of the vitally important grain and ore fleet. But this depletion only makes greater the contribution of the Lakes to the solution of the ocean shipping problem.

The yards were planned for building large-capacity lake ships and for repair and docking. Building small ships at maximum speed proved to be a new task, which soon threw the various departments of the yard out of balance. Even the best-proportioned yards had to rearrange their facilities and enlarge first one department and then another.

For example, the Toledo Shipbuilding Co. found its punch shop unable to keep up with the rush work on its six berths, early in the emergency shipbuilding. It had been considered an unusually well-balanced yard. The punch shop, designed for an output of 30 tons per day, was adequate for normal times, but now its production had to be increased. Night and day shifts were

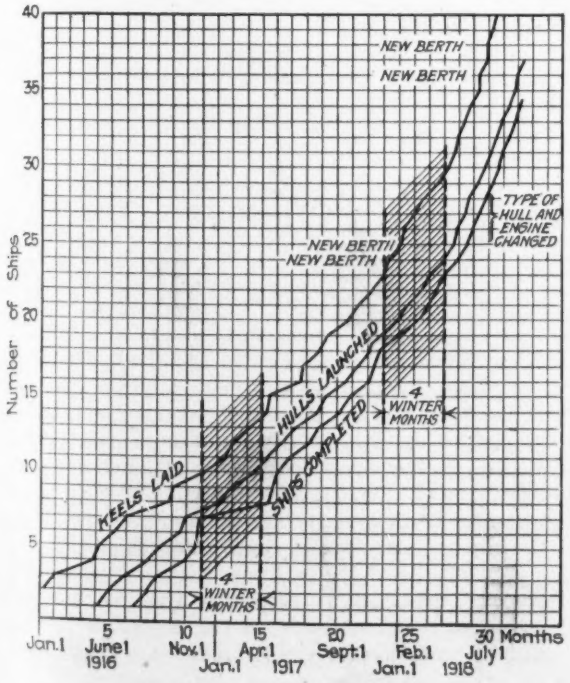


FIG. 2. REGULAR SHIP PRODUCTION AT WYANDOTTE

operated, and by concentration of work the output was raised from 24 lb. of steel per man-hour to 36. The shop then turned out 65 tons per day, making the yard production a little better than one ship per month. This is still far below the building capacity of the six berths, however, and enlargement of the punch shop by 35 to 40% is now being carried out; it is made possible by building a new machine shop in a distant corner of

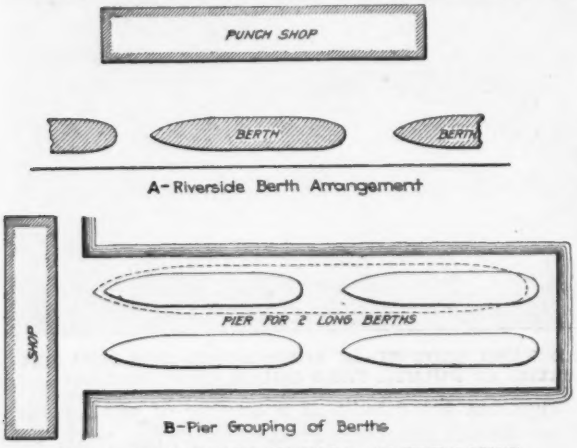


FIG. 4. TWO TYPES OF YARD ON THE LAKES

the yard, which will release the old shop, close by the punch shop, and permit its addition to the latter.

Inadequate provision for material storage, both raw and fabricated, shortage in compressor capacity and in crane service, and lack of pre-assembly facilities were among the items of deficiency that developed in nearly every yard, and, so far as the hull-building part of the yard is concerned, the rearrangement processes have been directed largely toward improvement in these services.

Characteristics of Great Lakes Shipbuilding

Two prominent features distinguish the Great Lakes work. First, side launching is used exclusively, and because of this fact the Lakes occupy a unique position among the world's shipyards. The yard layout and the shipbuilding equipment, being determined by the side-launching method, differ sharply from those found in seacoast yards. Second, the shipbuilding is being carried on by normal, everyday methods, though at high pressure for speed and quantity. No bridge-shop fabrication has been attempted by the Lakes yards.

This latter fact is specially interesting, because in nearly every yard conditions are similar to those previously sketched for Toledo: The hull production has been limited by the punch-shop capacity. At times scarcity of labor on the building berths made the hull erection lag behind the shop temporarily, but the record speed performances amply proved that with free supply of labor the erection work can be carried on at much faster rate than the punch-shops can meet.

Sharp contrast between the work of the Lakes yards and that of the big fabricated-ship yards of the Atlantic coast appears not only in the former's depending exclusively on yard-shop work, but also in their sticking to normal ship design. No simplification of outline or details has been attempted. The ship profile has pronounced sheer, the decks are heavily cambered, the sides have a distinct tumble-home, the bottom is shaped with 6-in. dead-rise from the keel, the tank top slopes down to the bilge, and its margins are turned down normal to the bilge strake. Because of the blunt proportions of the ship the parallel length is small. In fact, practically the whole of the ship is molded, which means that all elements of difficulty in shipbuilding are present.

Ships 261 ft. long and 43½ ft. wide in midship section are being built at all of the yards. These dimensions are the maximum for passage through the locks of the Welland Canal. When war-time shipbuilding began on the Lakes, through rush orders from Norwegian ship owners and the Cunard Line, in 1915, the main demand was for 3000-ton single-deck vessels 20 ft. 3 in. deep. A later design, calling for the molded depth of 24 ft. 2½ in., with an intermediate line of strongbeams (instead of a deck) in the hold to brace the frames, brought the carrying capacity up to 3500 dead-weight tons. Subsequently the Emergency Fleet orders called for vessels 28 ft. 2 in. deep, of 4200 tons capacity. Most of the yards are working to the same design drawings; in fact, only two designs of the 28-ft. ship are being built on the Lakes, as the result of the coöperation of the yards. All the ships are of the ordinary transverse-frame system of construction; their frame spacing is 24 inches.

Side launching can be done in water not much wider than the ship's breadth, so that the method is excellently

GREAT LAKES SHIPYARDS BUILDING OCEAN-GOING SHIPS FOR EMERGENCY FLEET CORPORATION

Location	Owner	Number of Building Berths for 261-Ft. Vessels Two years ago	Now
Buffalo, N. Y.,	American Shipbuilding Co.	1	6
Ashtabula, O.,	Great Lakes Engineering Works	2	4
Cleveland, O.,	American Shipbuilding Co.	2	3
Lorain, O.,	American Shipbuilding Co.	8	8
Toledo, O.,	Toledo Shipbuilding Co.	6	6
Detroit and Wyandotte, Mich.	American Shipbuilding Co.	4	10
Ecorse, Mich.,	Great Lakes Engineering Works	6	8
Saginaw, Mich.,	Saginaw Shipbuilding Co.	–	6
South Chicago, Ill.,	American Shipbuilding Co.	2	5
Manitowoc, Wis.,	Manitowoc Shipbuilding Co.	2	6
Duluth, Minn.,	McDougall-Duluth Co.	–	9
Superior, Wis.,	American Shipbuilding Co.	2	5
	Globe Shipbuilding Co.	–	5
	Total	35	81

YARDS BUILDING TUGS

Cleveland, O., Lake & Ocean Shipbuilding Co.
Port Huron, Mich., Foundation Co.
Marine City, Mich., S. C. McLouth.
Benton Harbor, Mich., Daehl-Carter Co.
Sturgeon Bay, Wis., Leatham & Smith Co.
Universal Shipbuilding Co.
Green Bay, Wis., Northwest Engineering Works.
Superior, Wis., Whitney Bros. Co.

suited to the narrow rivers flowing into the Lakes. But it is used also by yards located on wide rivers (Wyandotte and Ecorse on the Detroit, Toledo on the Maumee, McDougall on the St. Louis). Berth arrangements are of two types, the riverside (A, Fig. 4) and the slip-and-pier type (B, Fig. 4), the latter being most common. The greater berth capacity for a given river frontage of the slip-and-pier type is counterbalanced under the special conditions of the past year by the disadvantage of less easy expansion, on account of the dredging and pier construction required. In the expansion of the Wyandotte yard three riverside berths have been added to the seven slip berths.

(To be continued)

Road Maintenance Methods and Devices Effect Saving of Material, Labor and Fuel

Bureau of Maintenance and Repair, New York State Highway Department, Working Through Nine Division Engineers, Endeavors to Keep the War-Traffic Roads Open and Still Conserve Material

CONSERVATION of state resources in both labor and material has been the aim during the past season of the administration of the bureau of maintenance and repair, New York State Highway Department, and is on the program for next year's work. To aid in this aim, many innovations in labor-saving machinery, new methods of design and new kinds of material have been utilized. The bureau, working through the nine division engineers, has striven to keep its roads in condition to carry the heavy traffic, and at the same time to use as little material and labor as possible, thus conserving these national resources for war purposes.

The roads of the state are divided into four classes: State highways, county highways, county roads and town roads. The first are built entirely at state expense, the second at state, county and town expense, the third entirely at county expense, while the last are built by the towns, with state aid. There are at present approximately 7000 miles of state and county highways which have been improved and accepted by the state for maintenance purposes. Of these some 5800 miles have low-grade concrete and macadam-and-gravel surfaces, while most of the remainder have brick, concrete and bituminous surfaces of the higher classes. There is also a scattering of various stone-block, asphalt-block and other pavements.

All state highway activities are carried on under the supervision of three deputy commissioners, who are appointed by and are under the orders of the commissioner of highways. The first deputy has charge of the design and construction of all state and county highways, the second has charge of the maintenance and repair of these highways, and the third supervises the repair, improvement and maintenance of town highways and bridges upon which state money is expended. The organizations of the first and second departments converge in the division engineers, through whom they work, and who have direct control of all construction, maintenance and repair in their divisions on the state and county highways. The third deputy commissioner works directly through nine district supervisors who report to him. The work of his department consists of supervising and auditing expenditures on town highway work.

While the practice varies in the different divisions, it is customary for each division engineer to have an engineer of maintenance, who is directly in charge of the accepted state and county highways. He has charge of all patrolmen and gang foremen, and these report to him and receive instructions from him. The further organization taking care of the county and town roads consists of the county or district superintendents, who are appointed by either the board of supervisors or the highway commissioner, and the town superintendents who are elected by the towns in which they reside.

State and county highways are maintained at state expense, with the exception that each town must pay $50 into the state treasury for each mile of state and county highway within its borders, and each incorporated village must pay 1½c. per square yard for those highways within its corporate limits.

Both patrol and gang systems are used for maintenance. The second deputy commissioner reports that "the patrol system of constant maintenance is more efficient and more economical than the intermittent gang system for the maintenance of water-bound macadam pavements and gravel surfaces, particularly

FIG. 1. DESTROYED BY HEAVY TRAFFIC AS THE FROST WENT OUT IN EARLY SPRING

where surface treatment is restricted." When the work to be done is greater in amount than the individual patrolman can do, he is furnished with one or more helpers. The efficiency of the patrol system is reported to have been greatly increased by the introduction of a cost system for all labor items connected with the work. As a part of this record, the patrolman is required to enter the work done each day in a book, and at the end of the month he must summarize it and distribute his wages among the jobs done. This acts as a constant spur to the patrolman to have as much work as possible to report, so that the unit labor cost may be as small as possible. Gangs are used where extraordinary repairs are required, such as broken spots in hard-surface pavements, surface treatment, etc. In fact, where repairs are only in spots widely separated, or where they are so extensive as to require special machinery and a greater number of men, the patrol system is not considered

economical. The bureau believes that pavements which deteriorate quickly in spots, so that immediate repairs are required to save them, should be handled by patrol methods, while the gang system works better on more permanent pavements, such as brick and first-class concrete, where occasional holes develop slowly.

Not only do minor repairs and surface treatments come under the Bureau of Maintenance, but also resurfacing of accepted state and county highways and often complete reconstruction. During last winter many roads were practically destroyed in stretches, as shown in **Fig. 1,** by the heavy motor-truck traffic, and it was necessary for the department practically to reconstruct the roads. Some of this reconstruction was described in *Engineering News-Record* of Oct. 31, p. 808, and, as explained there, it exemplifies the saving being effected in material by rebuilding only those portions which have broken down, thus using the least amount of material which will keep the road in condition to carry heavy traffic. By following this method, fully 50% of the material which would have been required to reconstruct the road entirely was conserved at this time of shortage. While this partial reconstruction is no doubt more expensive per mile covered than continuous reconstruction, still the second deputy commissioner feels that it is necessary to coöperate with the Government in conserving labor, essential materials and transportation, and he has suggested to the division engineers the advisability of continuing the procedure on roads which are broken through during the coming winter. It is further planned to coöperate with the Federal Government by preserving the surfaces of all roads, as far as possible, by patching and by light treatments with bituminous material.

By far the greater part of the bureau's maintenance work consists of constant patching of the incipient holes by the patrolmen. Thin repairs on bituminous surfaces are made by painting them with light asphaltic oils or refined tar products and covering with stone chips or sand. Heavy binders requiring heating have been used in the same manner. It is stated that where the thickness of a patch is ½ in. or more, the most satisfactory results have been obtained by the use of "cold-patch" materials. These are of two kinds, those which consist of emulsions of asphalt with soap and water, and which are thin enough to mix with materials when cold, and those which are kept in fluid condition by a cut-back of volatile oils. Both preparations are convenient for the patrolman, as they obviate the necessity of transporting a heating kettle.

When a defective section of the surface has been cut out and cleaned, the patrolman takes the required amount of crushed stone and mixes it with the "cold-patch" material in about the proportion of one gallon of the material to 1 cu.ft. of stone. When this is tamped in place, the emulsion breaks down or the volatile oil evaporates, the patch becoming as solid as the remainder of the surface. The best results with asphalt cut-back have been obtained by using asphalt with a penetration of about 165, fluxed with 33% in weight of naphtha. When refined tar products are used, the best results have been obtained with a binder having a melting point of 70° C., fluxed with 40% in weight of tar oils of which at least 60% will distill up to 235° C. Emulsified "cold-patch" sets more quickly than the cut-back preparations, but it is hard to use in cold weather, as freezing breaks down the emulsion.

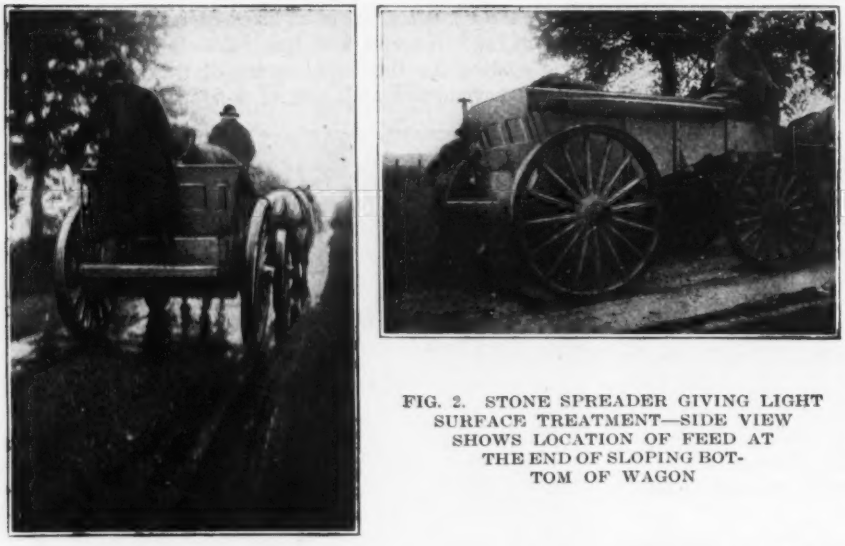


FIG. 2. STONE SPREADER GIVING LIGHT SURFACE TREATMENT—SIDE VIEW SHOWS LOCATION OF FEED AT THE END OF SLOPING BOTTOM OF WAGON

Next to the patrol work, light surface treatments are most extensively used, consisting of an application of cold bituminous material and a covering of stone chips. The bituminous material is generally spread with a motorized power distributor. It is the policy of the department to give as few surface treatments as possible, since they tend, if used too often, to pile up and become soft. It is thought better to allow them to wear down as thin as possible, although considerable patching is required during the later periods of wear.

A labor-saving device for spreading stone chips is shown in Fig. 2. It was made by reconstructing an old horse-drawn oil distributor in the blacksmith shops of the department. Fig. 3 shows a cross-section detail of the feed. These wagons follow the oil distributor closely, spreading a thin covering of stone chips over the surface of the tar. The feed may be regulated by means of the door, so as to spread anywhere from 10 to 35 lb. of stone per square yard of surface. The feed is operated by an 18-in. sprocket. The chain from this sprocket passes to a 4-

FIG. 3. FEED CAN BE REGULATED TO SPREAD FROM 10 TO 35 POUNDS OF STONE PER SQUARE YARD

in. sprocket on a cross shaft which is in turn geared to the feed. Sloping bottoms are placed in the wagons, so that with dry material there is no trouble in emptying. A gang of 10 men will oil and cover from two to three miles of 16-ft. road per day, giving an application of 2000 gal. to the mile and 15 to 20 lb. of stone to the square yard. By the old method of distributing the covering stone in small piles along the road and speading by hand, a gang of 30 men would be required to do the same amount of work. Thus a great labor saving is effected. In the division where the stone spreaders shown in the views are working, the contract prices for light-oil treatments have been cut 50% by the use of this device.

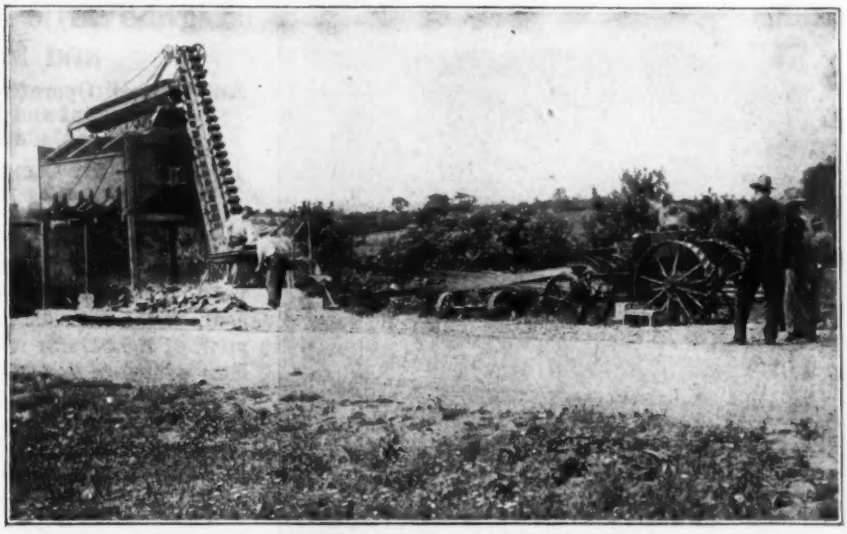


FIG. 4. OUTFIT PREPARES COVERING STONE FOR SURFACE TREATMENT

In many sections of the state transportation facilities are very poor, and an effort is being made to conserve them as much as possible by the preparation of materials along the highways. Fig. 4 shows an outfit preparing covering stone for surface treatment. Local stone is being used. This is crushed in a jaw crusher and then run through rollers which break it into the small sizes required for patching and covering. From the roller it passes by the elevator into a rotary screen which removes the dust and spalls. The power is supplied from the flywheel of a small tractor, which is also used to transport the apparatus to a new location when work on any section is completed. This outfit will produce 30 cu.yd. of covering stone in 10 hours.

Where the hand method of spreading screenings is used, the motor-truck equipment shown in Fig. 5 has been found very convenient. The chute can be attached to either side of the truck, and the amount of covering stone placed in each pile can be regulated by the sliding door and the lever. At railway sidings special unloading equipment is being used to fill the trucks, thus effecting a further labor saving.

Intermediate between patching and surface treatments and complete reconstruction come various forms of resurfacing. Resurfacing is done when it is no longer feasible to patch the old surface. During the season of 1917-18 very successful results have been obtained by resurfacing with "cold-patch" material. As the name would imply, this was not the use originally contemplated for this material; however, not only does it give a satisfactory surface, but it also effects a considerable saving in fuel which would have to be used if hot bituminous materials were employed.

Detailed costs of a job resurfaced by this method in 1917 are given in the accompanying table. In the laying, the crushed stone and "cold-patch" mixture, which in this case was of the emulsified type, were mixed together in a batch concrete mixer and spread to the required thickness upon the road. This was allowed to set for a short time, and was then rolled into shape with a heavy roller. The engineer in charge of the work says the costs were higher than they otherwise would have been, on account of rainy weather, which required the drying and cleaning of the stone before it could be used. Local crushed limestone was used, the thickness of surfacing being 2 in. in places. The road received a seal coat of Tarvia A, early in the season of 1918, and it is stated that it has a fine surface, with the appearance of a Topeka mix. The highway is a heavy-traffic line between Rochester and Buffalo; it is 16 ft. wide and 3900 ft. long, or 6933 sq.yd. Originally, the road was

COST OF RESURFACING OLD MACADAM WITH "COLD-PATCH" MATERIAL

Itemized Cost

Materials:		
224 tons No. 2 stone purchased at $1.65 per ton	$369.60	
60 tons No. 2 stone from maintenance piles at $1.65 per ton	99.00	
331 tons No. 1 stone purchased at $1.90 per ton	628.90	
10,700 gal. bit. mat. C. P. A. E. at 0.1392 per gal.	1,489.44	
	$2,586.94	
Labor and equipment:		
Labor and teams	1,316.35	
Foreman	112.00	
Steam roller, 27½ days at $12 per day	330.00	
Water tank, rent	24.00	
5-ton motor truck	120.00	
1½-ton motor truck	168.00	
	$2,070.35	
Supplies:		
8.895 tons coal for steam roller	69.00	
4 gal. oil	2.00	
110 gal. gasoline for concrete mixer	29.70	
8 batteries for engine on mixer	2.80	
Oil, grease, waste wood for roller, etc	9.04	
Repairs to engine on concrete mixer	5.00	
	$117.54	
Total cost of work		$4,774.83

Distribution of Cost

Materials—total cost for work	$2,586.94	
Unloading and hauling bituminous material, 4-mile haul	157.56	
Hauling plant	20.00	
Loading and hauling stone from maintenance piles	60.00	
Repairing holes, material not included	125.30	
Manipulation of pavement, including screening the stone	1,770.09	
Making and scraping shoulders, cleaning up	55.00	
Total		$4,774.83

Unit Costs on 6,933 Square Yards

Total cost, including shoulder work	$4,774.83–$0.688	per sq.yd.
Total cost, excluding shoulder work and including repairs to holes	$4,719.83–$0.68	per sq.yd.
Total cost, excluding shoulder work, labor and material in repairing holes	$4,524.68–$0.65	per sq.yd.
Cost of manipulation on pavement	$0.255	per sq.yd.

FIG. 5. COVERING STONE DISTRIBUTOR WITH CHUTE IN PLACE, OTHER OPENING BEHIND OPERATOR

of water-bound macadam, built in 1902, and it had been resurfaced with Rocmoc in 1910. At the time of resurfacing in 1917, it was worn in holes from 1 to 4 in. deep and was very rough. The holes were first repaired, and then the surface was laid and the shoulders were reshaped and cleaned.

Besides the equipment mentioned above the department has many other kinds of highway-building machinery, such as steam rollers, motor trucks and unloading apparatus, and is experimenting with tractors for hauling road scrapers in shaping shoulders and cleaning ditches. The tractors are reported to be working very satisfactorily, and are said to be able to go anywhere that a team can go, but as yet they have not been used long enough to provide reliable cost data as to their efficiency.

All work in the Bureau of Maintenance and Repair is under the supervision of F. W. Sarr, second deputy commissioner of highways, who holds this appointment under Edwin Duffey, state commissioner of highways.

Hard-Road Maintenance Costs in Illinois

Illinois has 270 miles of state concrete roads, and while these roads are scattered in short sections all over the state the maintenance cost in 1917 averaged $30.25 per mile for the slab and $51.20 for the shoulders. For 59 miles of brick roads maintenance of the surface cost $5.36 and of the shoulders $51.20. These figures were given out by Clifford Older, chief highway engineer of the State Highway Commission, and were used in the mass of propaganda put out during the recent Illinois campaign for the $60,000,000 bond issue. This bond issue, which was voted upon favorably on Nov. 5, provides for the construction of 4800 miles of hard-surface roads.

Light-Traffic Railway vs. Highway and Motor Truck

Analyses of Operating Expenses, Fixed Charges and Amount and Kind of Traffic Should Be Made for Each Case

By Clement C. Williams
Professor of Railway Engineering, University of Kansas, Lawrence

MANY of the small railroads have been left out of the Federal Government's unified system of railways. This action of the Government calls attention again to the economic principles that underlie the operation of light-traffic railways, and, although the problems related to the war are of primary importance at the present time, yet matters pertaining to the existing as well as to the permanent economic and industrial organization must not be entirely overlooked. Even though the railroads after the war are returned to private ownership and private operation, they will doubtless be retained on a coöperative, unified basis rather than be restored to the quasi-competitive status that they occupied previous to their being leased by the Government. Careful consideration should be given, therefore, to the problem of devising for the nation the most economic, unified and comprehensive transportation system possible, including the waterways, railways (steam and electric) and the highways. The present discussion deals only with a certain phase of the last-named two modes of transportation; viz., the economic status of light-traffic railways and their relative advantages as compared with highways.

The advent and rapid development of motor trucks have rendered obsolete the data and conclusions which have governed the relationship between railways and highways predicated on transportation by horse-drawn vehicles on the latter. Studies should be made, therefore, into the economics of operation of motor vehicles in order that we may arrive at correct conclusions, for the conditions and results of their operation are not so well known as those pertaining to railways. The general adoption of standard types of trucks and trailers would greatly aid, in this connection.

Junking the Colorado Midland

The question as to the relative economy of a railway or a highway as an instrumentality of transportation is at once raised in the proposal to junk the Colorado Midland R.R., in accordance with a recent court order, and to build a highway on the existing roadbed. Obviously, the one will be more economical than the other if it will transport the total traffic to be carried at a less total cost than the other. Axiomatically, the total cost of transporting traffic consists of two elements; viz., fixed charges—that is, interest on the capital invested in roadway and equipment—and the operating costs. A railway will be the more economical, therefore, when $F_r + O_r < F_h + O_h$, where F_r is the yearly fixed charge and O_r the yearly operating cost on the railroad for carrying the entire traffic to be transported, and F_h and O_h are the corresponding quantities for the highway.

A railway is a highly specialized type of highway requiring special equipment, terminal facilities and so forth, and the fixed charges are relatively high, with a

corresponding reduction of operating expenses over the ordinary highway. If the total amount of traffic to be transported is not sufficient in amount to make the reduction in operating expense compensate for the increased fixed charge due to special roadway, equipment and terminal facilities, then the highway with its lower fixed charge will be the cheaper mode of transporting the relatively small amount of freight. Light-traffic railways generally serve chiefly as feeders, carrying traffic to connecting lines, and in this respect as well as in their local service they are comparable in function with highways similarly located.

Comparative Figures

From the 1915 report of the Interstate Commerce Commission the following statistics are obtained. From them crude estimates can be made which will illustrate the comparative economy of a light-traffic railway and a highway. Corresponding figures are also given for the Atchison, Topeka & Santa Fé Ry., with which the Colorado Midland connects, in order to indicate the distinction between a line carrying normal traffic and a light-traffic road. These latter do not require comment.

COMPARATIVE FIGURES FOR LIGHT-TRAFFIC AND TRUNK-LINE RAILWAY

	Colorado Midland	Santa Fe
Total stock and funded debt	$18,884,208	$707,400,991
Total traffic, ton-miles	88,970,000	6,347,563,000
Average tonnage per train	206.5	360.1
Average operating expense per train-mile	$1.91	$1.65
Average operating expense per ton-mile	$0.0093	$0.0046
Same, exclusive of maintenance of way and structures	$0.0074	$0.0031
Same, for maintenance of way and structures	$0.0019	$0.0015
Length of line owned, miles	261.1	7,155.5
Average length of haul, miles	134	288

Assume an investment in the highway of $10,000 per mile, or a total for the 261 miles of $2,610,000. If each truck to be used had a capacity of 200 ton-miles per day for 300 days per year, approximately 1500 trucks would be required. At $3500 each, the investment in trucks would be $5,250,000, making a total investment for the highway of $7,860,000. From various records, the average cost of hauling on motor trucks without trailers may be taken at 7c. per ton-mile for operating expenses, exclusive of maintenance of the highway. If trailers are used, the cost might be reduced to perhaps 4c. per ton-mile, and the investment in rolling stock to perhaps $2,200,000. The maintenance of a highway chargeable to trucks may be assumed as $200 per mile per year. On this basis, the cost of hauling the 88,970,000 ton-miles of traffic on the Midland and on the highway would be as follows:

	Colorado Midland	Highway	
		Without Trailers	With Trailers
Operating expense, exclusive of maintenance of way	$658,400	$6,827,900	$3,538,800
Maintenance of way and structures	170,000	52,200	52,200
Fixed charge (at 6%)	1,133,050	471,600	288,000
	$1,961,450	$7,351,700	$3,979,600

Had the traffic been only 2,000,000 ton-miles, under the above conditions the investment in trucks would have been about $115,500 and the cost of transportation over the highway would have been $1,400,000 + $163,500 + $52,200 = $1,615,700, which would have been cheaper than the cost by rail. However, if the traffic were appreciably less, the unit cost of operation on the railroad would be greater, so that the traffic would not have to be reduced as low as this figure before the highway would be the more economical. In the case of the Colorado Midland, diversion of a legitimate amount of the traffic to the Denver & Rio Grande R.R., and hauling by the most direct routes, might possibly reduce the traffic and average length of haul to such an extent that the highway would be the more economical means of transportation for the traffic handled at present. As the figures stand, however, the railroad appears to be the more economical, and the question of junking it resolves itself into the general economic situation—whether the transportation of this traffic by any means at the necessary cost is justified.

Other Data to Be Considered

Conclusions of this sort, in order to be reliable, must necessarily take into account specific data and the characteristics of the traffic and of the railroad. The average length of haul and the question whether the traffic is local or through to a connecting line affect the solution of the problem, as well as does the total ton-mileage. Short-haul local traffic may be more economically and more expeditiously transported by truck because of the expense and delay of additional handling in loading and unloading on the railroad, while, on the other hand freight that is to be carried farther on a connecting railroad must be loaded into cars ultimately and therefore can be conveniently placed in the cars at the beginning of the route. In general, truck hauling is feasible and economical only for the short hauls, and trucks should be operated to supplement the railways rather than to compete with them; also, the circumstances under which either mode of transportation may be the more economical can be determined with fair definiteness.

Of course, the entire question of junking the Colorado Midland, which has been operated at a loss since 1908, is not so simple and elementary as above outlined, involving, as the matter does, tourist passenger service and other factors, but it is believed that the above discussion suggests a rational method of determining the economic border line between the province of the railroad and that of the highway, where specific data are available instead of gross general averages.

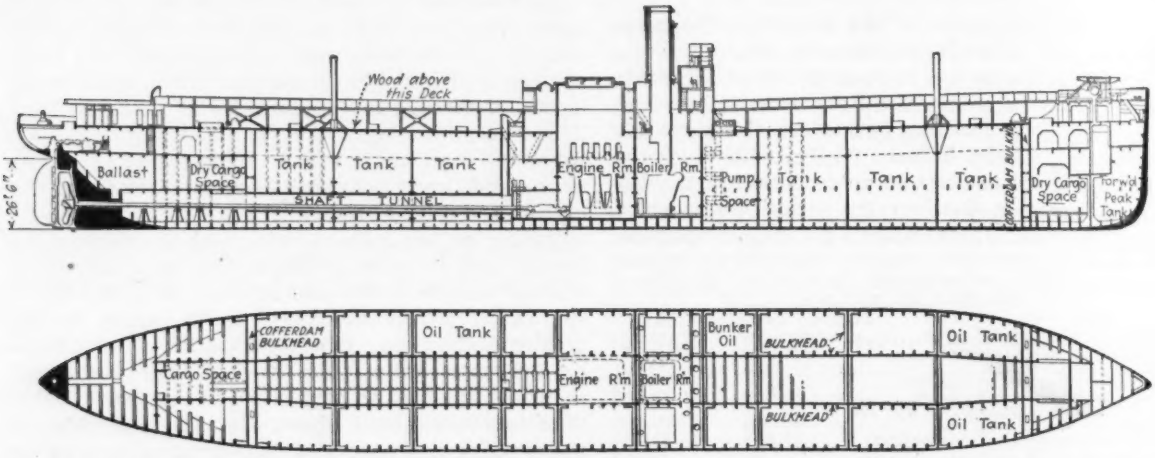
Profitable War Gardens Made Possible By Water Company's Gift

From 37,000 war gardens in Denver, Colo., for which the Denver Union Water Co. furnished free water, the estimated yield is valued at $2,600,000. It is asserted that this direct war service derives its greatest value from the fact that the necessity for hauling in foodstuffs is reduced by the gardens. In 1917 the yield from 31,000 gardens was estimated at $2,000,000 by Prof. P. L. Clarke, in charge of the water company's garden department, after inspection of a large number of gardens. The 1918 estimate was made by telephoning to several hundred persons and inquiring as to the increase in yield over the previous year. From this information, plus the increase in number, the company estimated a total increase in value of 30%. The National War Garden Commission in Washington estimated the average yield of gardens all over the country as $100 per garden, which would make the value of the 37,000 gardens in Denver $1,100,000 more than the company estimated.

Different Types of Framing in Two New Government Reinforced-Concrete Ships

7500-Ton Oil Tanker Has Close-Spaced Frames With Vertical and Horizontal Reinforcing in Shell, While 2500-Ton Schooner Barge Has Long-Span Framing System With Diagonal Shell Reinforcement

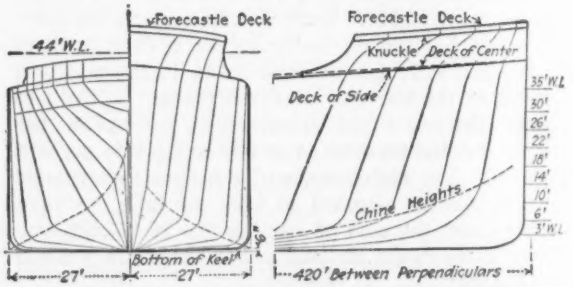
TWO distinct systems of concrete-ship framing are represented in the latest types of design issued by the concrete ship department of the Emergency Fleet Corporation. In one of these, a 7500-ton oil tanker, the main transverse frames are closely spaced, following long-established practice in wood- and steel-ship design. In the other, a 2500-ton schooner barge which is to be used for carrying coal in the New England trade, the frames are spaced about 22½ ft. apart, and the hull is additionally stiffened by a thickening of the side shell, forming what is in effect a longitudinal stringer there. In the large boat no diagonal reinforcing is in the shell, except occasional spacer bars. In the schooner, however, heavy diagonal reinforcing is provided in the shell, in addition to vertical shear steel.



CONCRETE OIL TANKER OF 7500 TONS DEAD-WEIGHT CARRYING CAPACITY BEING BUILT BY UNITED STATES
Four hundred and twenty feet long between perpendiculars; 434 feet 3 inches long over all; 36 feet deep; 54-foot beam

The 7500-ton oil tanker and its companion ship, the 7500-ton freight carrier, both of which have been designed by the concrete ship department, are the largest concrete ships ever attempted. Both ships are to be built in the five Government yards now under construction, but the tanker will be the first to be laid down. It is expected that the first hull will be launched in February, 1919. General details of the tanker design are given in accompanying drawings. The main dimensions are as follows: Length between perpendiculars, 420 ft.; length over all, 434 ft. 3 in.; molded depth at side, 36 ft.; beam, 54 ft.; designed loaded draft, 26 ft. The vessel will be driven by 2800-hp. reciprocating engines connected to a single screw. The boilers are oil-burning. Contrary to the usual practice with steel-tanker design, the engines and boilers are amidships. This more desirable location was selected because the oil-tightness of the shaft tunnel could be insured in a concrete structure, although in the steel tankers such tightness is not so certain.

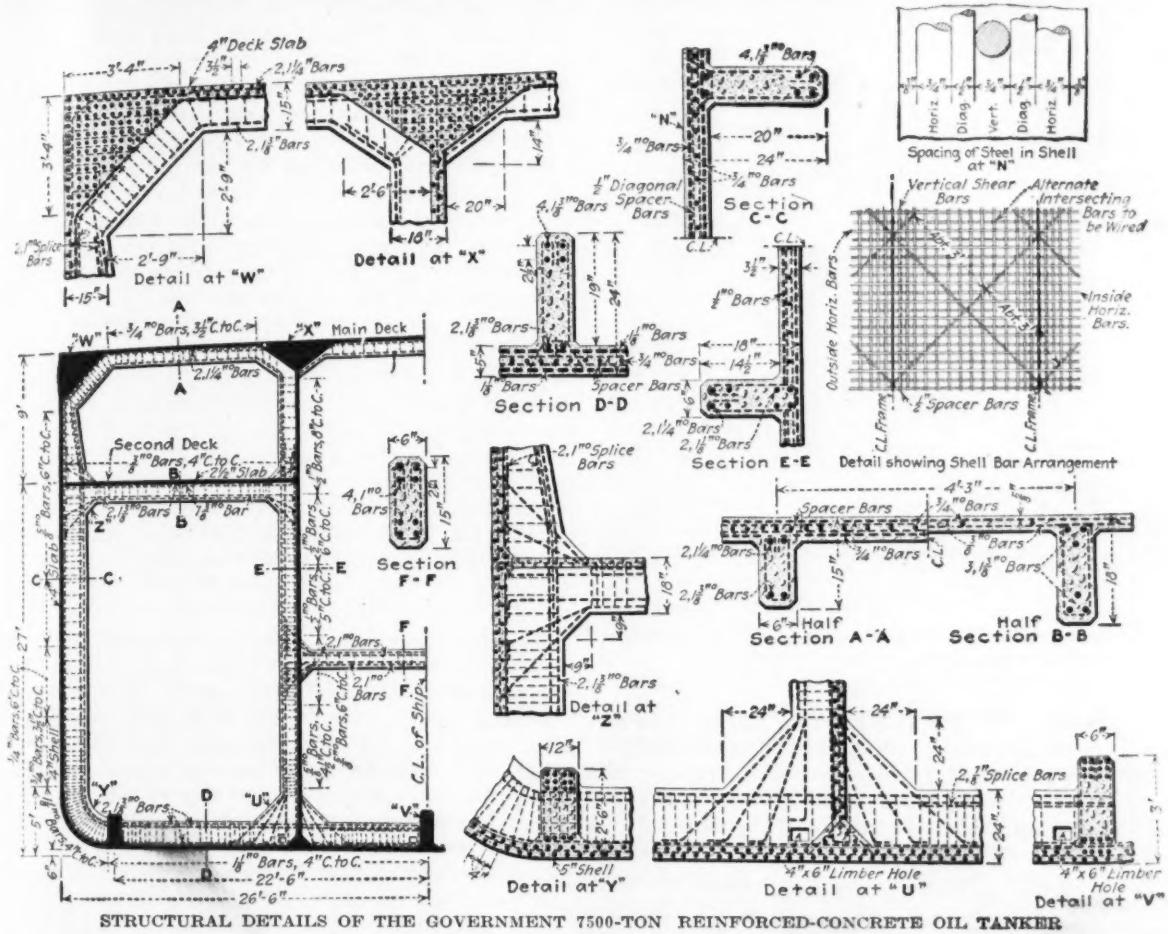
Simplified ship lines are used in the design of the hull. As shown in the drawing of the lines, about 50% of the mid-length of the boat is practically rectangular in section, the only divergence from rectangularity being the 6-in. dead rise, the 10-in. deck camber, and the circular bilge curves. At the bow and stern the chine is a simplified form and the bilge curves have the same radius, so that the vertical rods in the frames, which



LINES OF THE 7500-TON CONCRETE TANKER

are 6 x 24-in. girders spaced 4 ft. x 3 in. on centers, can be bent around the same curve, thus simplifying the steel fabrication exceedingly over the fabrication for a ship of faired lines, because of the possibility of using the same templet curve on the bending table for all frame steel.

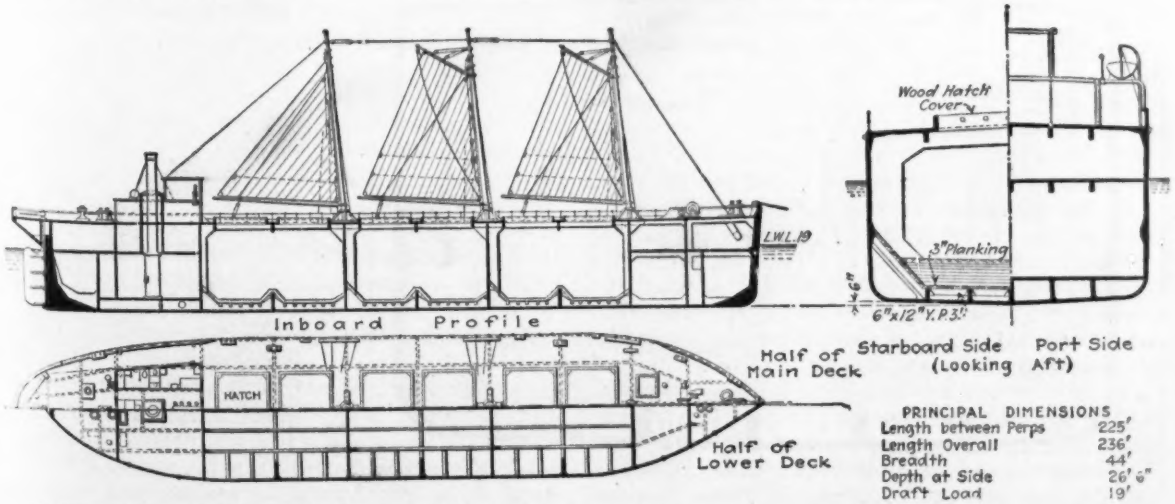
The hull is divided into a number of oil-tight tanks by two longitudinal and numerous transverse bulkheads. The longitudinal bulkheads consist of 3½-in. continuous reinforced-concrete plates backing against vertically placed reinforced-concrete beams which are braced at the lower third of the center tank by cross struts and in the upper third of the outside tank by a reinforced-concrete slab-and-girder floor. The latter



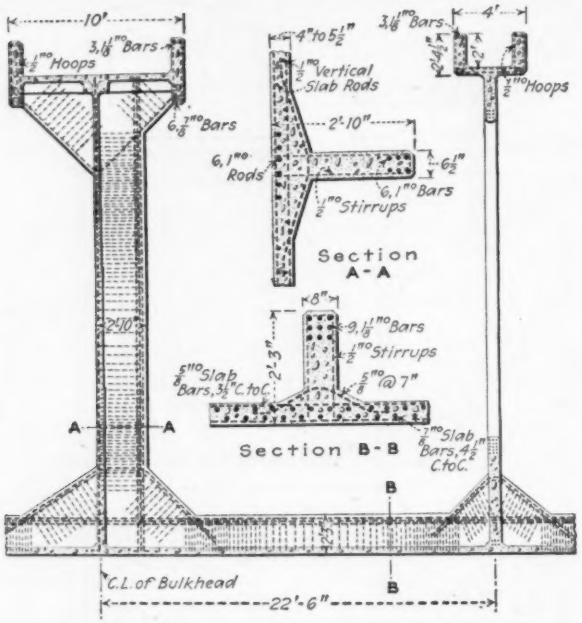
STRUCTURAL DETAILS OF THE GOVERNMENT 7500-TON REINFORCED-CONCRETE OIL TANKER

separates the lower tank from an upper or summer tank to be used in warm weather when the oil is light. There are a center and two side keelsons, which are heavy reinforced-concrete girders. The main deck is a 4-in. slab on 6 x 15-in. stringers in line and continuous with the side frames.

The transverse bulkheads are of slab and horizontal beam construction. Near the stern and bow, at the extreme ends of the oil tanks, the bulkheads are of the cofferdam type common to oil tankers. This bulkhead is two vertical transverse walls crossbraced with beams in horizontal planes and with the two longitudinal bulkheads. The two bulkhead walls are in the line with adjoining frames of the ship.



CONCRETE SCHOONER BARGE OF 2500-TON CAPACITY, DESIGNED BY EMERGENCY FLEET CORPORATION, HAS WIDELY SPACED FRAMES



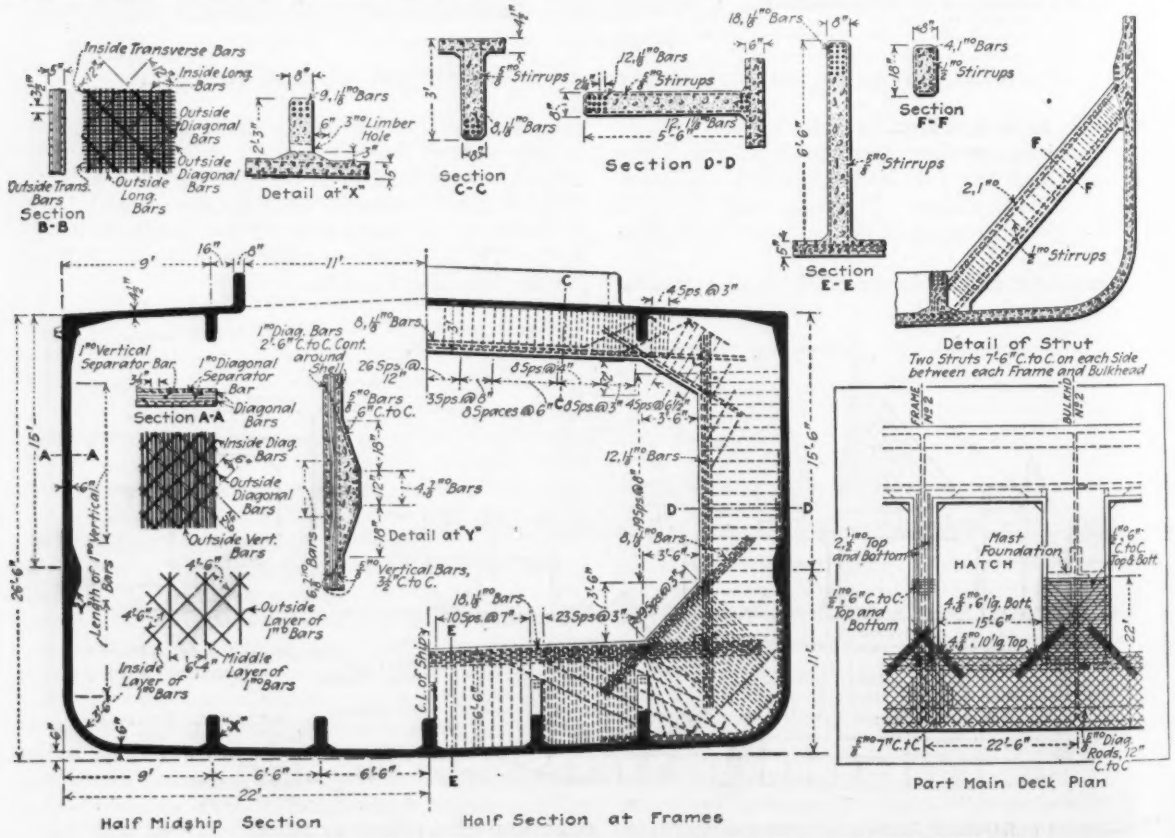
LONGITUDINAL SECTION OF 2500-TON CONCRETE SCHOONER, SHOWING DETAILS OF MAIN AND INTERMEDIATE FRAMES

In common with the 3500-ton ship of the concrete ship department, the stern frame of the 7500-ton tanker is an iron casting tied into the concrete of the stern frame with cross-bolts seated against an outside steel shell which makes the concrete form there.

The reinforcement for the 7500-ton tanker is detailed in all its elements in the main office of the Emergency Fleet Corporation. Exact following of these details as to sizes is not required of the individual yards, but all changes as to sizes and arrangement of details must be approved by the house office and must furthermore give an equal amount of metal as the official design and have equal stability of details.

As shown in the illustration of the midship section of the hull, the main reinforcement for the frame consists of 1⅜-in. bars, two of them at the shell end and four at the inner end. These bars are bent only in a radial curve at the bilge, with a slight curve at the connection of the deck and sides. Shear is taken care of in the frames by U-stirrups. Intermediate floor stringers, cross-brace stringers and bulkhead stringers are all tied into the main frame by rods with one bend only and with a hooked end, as shown in the drawing, thus simplifying steel fabrication and assembly at the joint. A great amount of steel is required at the heavy girder made up in the triangular corner between the deck and the sides of the hull. This steel is detailed as 1⅛-in. round bars, tied together with intertwined stirrups.

The shell, which is 5 in. thick on the bottom and 4 in. thick on the sides, is reinforced with an outer and an inner layer of horizontal rods varying from ⅜ in. at the bottom to ⅝ in. near the top of the sides and spaced 4 in. on centers, the outer and inner rows staggering. These are to take care of the local longitudinal stresses due to bending. Shear is cared for by ¾-in. vertical rods, 4 in. on centers between frames and 2½ in. on



DETAILS OF REINFORCED CONCRETE IN 2500-TON CONCRETE SCHOONER

centers at the frames. As spacers to keep these rods in position and a distance of ⅜ in. from the outside and inside surface, ½-in. rods are spaced diagonally on 3-ft. centers on the shell. These rods are run between the horizontal and vertical rods, as shown in the diagrammatic view on one of the drawings of this hull section. Alternate horizontal bars are to be wired to the alternate vertical bars.

2500-Ton Schooner on Novel Lines

The 2500-ton coal barge is a novel type in the concrete vessel. It is 236 ft. long over all, 44 ft. wide, and 26½ ft. deep at the sides. The carrying capacity is 2500 tons. The vessel is schooner rigged, as shown in the drawing. Bids for the construction of a number of these ships were asked for early in October, but decision on contracts has never been made.

The vessel's framing, partly governed by the necessity for so many hatch openings in the decks, is distinctly novel. It consists of deep transverse frames spaced on 22½-ft. centers, carrying a heavy shell for the most part of 6-in. thickness, which is additionally braced at the third points between frames by diagonal concrete struts at the bilge angle. The ship is divided into compartments by a transverse bulkhead at every other frame and also by collision bulkheads at the bow and stern, in the stores and service sections of the boat. Longitudinal stiffness is obtained by six keelsons, which are heavy reinforced-concrete girders.

The transverse frames are 6½ ft. deep on the bottom, 5½ ft. deep at the side and 3 ft. deep under the deck. They are reinforced with bars, the maximum size being 1¼ in., laid straight along the respective frames, the connection at the bilge and deck curves being made with additional diagonal rods, as shown in the drawing. (In fact, there are no curved bars in the reinforcement except for the hooked ends.) This is a device to save fabrication costs. Intermediate of the frames are the two diagonal struts which foot at the bottom into the outside of the outside keelsons and frame at the top into a thickened section of the shell, which is continuous along the shell and is reinforced longitudinally. The struts are 8 x 18-in. sections, reinforced with straight rods.

Shell reinforcement of this schooner consists of inside and outside rows of vertical bars, and inside and outside rows of diagonal bars, the vertical bars being spaced 3½ in. c. to c., the diagonal bars 6 in. c. to c. Details are shown on one of the drawings. Here the vertical bars take the shear, and the diagonal bars the bending stresses. It will be noted that there are no heavy longitudinal girders at the intersection of the sides and the deck, as are common to the other large concrete ships. The bottom of the shell has the usual longitudinal and transverse bars, with diagonal spacer bars on 12-in. centers. The deck is reinforced with diagonal rods with extra longitudinal rods between hatches.

The bottom of the coal bunkers will be covered with wood flooring backed to wooden joists which are hung from special hangers attached to the concrete members of the hull bottom. The schooner has provision for a small crew, and has also a donkey engine at the stern for handling operations.

In both of these designs the concrete ship department has used the following unit stresses:

CONCRETE:

(1) Maximum unit compressive stress in the extreme fiber in flexure ..... 1500 lb. per square inch

(2) Maximum unit compressive stress in the extreme fiber in flexure, adjacent to support of a continuous or fixed-ended beam ..... 1700 lb. per square inch

(3) Maximum unit compressive stress in stanchions ..... 1000 lb. per square inch

(4) Maximum unit shearing stress $\frac{V}{(bjd)}$ in T beams and in shell or other slabs ..... 500 lb. per square inch
In isolated beams ..... 300 lb. per square inch

(5) When the maximum unit shearing stress is less than 50 lb. per square inch, the concrete may be considered to carry all the shear.

(6) When the unit shearing stress is greater than 50 lb. per square inch, reinforcement should be provided as follows: (*a*) In the design of thin slabs, used as the webs of beams, with the shearing action perpendicular to any local shearing stress such as the shell, provide shear reinforcement according to a formula for combining shear and local stresses. (*b*) In all other cases provide shear reinforcement to carry the full amount of the shear.

(7) Maximum unit bond stress not over ..... 160 lb. per square inch for steel stresses of 16,000 lb., and proportionately for other steel stresses.

(8) $\frac{Es}{Ec} = 10$

STEEL:

(1) Maximum unit tensile stress in all reinforcement, except as stated below, not to exceed ... 16,000 lb. per square inch
(*a*) In all bulkheads except collision bulkheads .. 20,000 lb. per square inch
(*b*) In shell reinforcement exposed to water ..... 12,000 lb. per square inch
(*c*) Maximum unit tensile stress in top steel of keelsons due to combined local and hogging or sagging stresses ..... not to exceed 20,000 lb. per square inch

San Francisco Plans Separate Garbage Collection and Utilization

Municipal authorities in San Francisco have been giving much attention of late to the garbage disposal question, and it is probable that in the very near future an ordinance will be passed requiring the segregation of food waste from rubbish and other refuse that would not be useful for hog feed. At present garbage collections are made at intervals ranging from every day to twice a week. After the segregation plan goes into effect the smaller cans containing the perishable garbage will be emptied as frequently as conditions demand, while the larger, or rubbish, cans from the average household will require to be emptied only once or twice a month. The amount of garbage collected in San Francisco has been decreasing rapidly, which is believed to be an evidence of "Hooverizing." Although the population of the city has been increasing steadily and rapidly, the amount of garbage in tons per month for the past two years has varied as follows:

Month	1916	1917	1918
January	14,830	13,696	11,537
February	13,524	11,313	10,211
March	13,898	12,092	10,811
April	12,492	10,715	10,605
May	12,438	10,803	10,299
June	11,760	10,211	9,329
July	12,078	10,318	.....
August	13,780	11,846	.....
September	13,541	11,121	.....
October	13,482	11,861	.....
November	12,173	10,926	.....
December	13,347	11,414	.....

It is likely that the new plan will not require hotels and restaurants to turn over their garbage to collectors designated by the city because they have contracts for disposal, some of which extend for two years and the abrogation of which would probably be fought as a confiscatory measure. The new plan will deal, rather, with the garbage from household sources. Some of the hotels are getting $5 per ton for garbage, but it is understood that this quality is superior as hog feed to that which would be obtained from households.

Capacity of Macadam Roads for War Business Increased

Three-Foot Concrete Shoulders Added at Each Side Without Closing Highways to Traffic — War Labor Conserved by Using Convicts for the Construction

CONSTRUCTION of 3-ft. concrete shoulders on each side of macadam roads in the State of Maryland was designed to increase their capacity for war business, while at the same time present traffic would not be interfered with. Besides increasing the capacity of the roads, the shoulders were intended to support the edges of the highways and were expected to distribute the traffic more generally over their entire surfaces. Every effort has been made in the construction to conserve labor by the use of machinery and by the use of convicts for the ordinary work.

The State of Maryland has many miles of surface-treated water-bound macadam roads which were built before modern concentrations of traffic were contemplated, and until recently they had given satisfaction. During the past winter, however, these roads suffered considerably from the increased traffic due to the war,

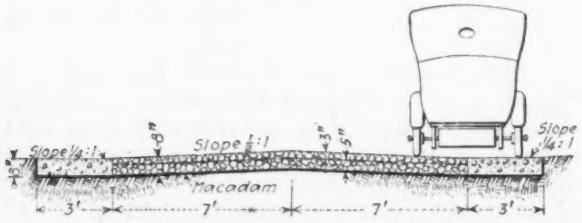


FIG. 1. CONCRETE SHOULDERS PROTECT EDGES OF MACADAM, INCREASE CAPACITY OF ROAD AND DISTRIBUTE TRAFFIC

and it became increasingly evident that something must be done to preserve them. Inspection showed that the greater part of the wear occurred at the edges, while the central part of the macadam remained in good condition. Large holes formed at the edges, extending one or two feet in, and ruts formed along the sides, causing a gradual spreading of the road crust away from the center line. To remedy this condition, it was thought that concrete supporting shoulders covering the parts most affected would not only be effective, but would increase the capacity and save the investment in the central portion of the surfacing, where very little wear had occurred.

With this idea in view, the Roads Commission decided to try out the design on the Baltimore and Washington Boulevard. It was proposed to construct one shoulder at a time, thus leaving the other side of the road open for the heavy war traffic, which it was realized could not be interfered with.

As originally constructed, the road was 16 ft. wide and 8 in. thick. In the spring of 1918 the condition of its surface varied greatly. In some places the surface was too badly destroyed to warrant anything but reconstruction; in others the only parts affected were the edges, which had broken down and rutted, the surface having been pushed out at the side and shoved up in large hummocks—in places 18 in. high. This had decreased its width from 16 to 13 or 14 ft., and 14 ft. was taken as standard width of macadam surface to be retained, while the addition of two 3-ft. shoulders would make a total width of 20 ft. In sections where the road was too badly injured to warrant saving, a 20-ft. concrete road was built. On these 20-ft. sections the design called for building 10 ft. at a time, thus keeping the road open to traffic, and this method was followed except in some places where good detours could be obtained. It is proposed to use the central macadam strip, where the concrete shoulders are being constructed, until such time as it requires reconstruction, when it will be removed and the entire center replaced with concrete, thus making the road conform to the 20-ft. sections now being built.

General dimensions and arrangement of the cross-section are shown in Fig. 1. The old 8-in. macadam had a crown of 4 to 5 in. and a parabolic cross-section. It was deemed unwise to continue this in the concrete shoulders, as they would be too steep, and a slope of ¼ in. to the foot was adopted.

In construction, the plan followed is to dig trenches along each side to 8 in. below finished grade, remove the present surfacing where it is injured and grade the forms so that the top surface of the shoulder will be slightly above the old surface of the macadam. The shoulders are being built one at a time, and after the concrete has been placed long enough to bear traffic new bituminous macadam is constructed between its inner edge and the old surfacing. The top of the old surface is roughened sufficiently to make a good joint with the material used to bring it up even with the tops of the shoulders. After this joint is completed, that side of the road is opened up to traffic, and construction on the other side proceeds. When the work is finished it is proposed to give the central strip a surface treatment

FIG. 2. LABOR SAVED BY USE OF MACHINERY

of approximately ¼ gal. of bituminous material per square yard, and cover it with stone chips at the rate of 100 tons to the mile. The drawing shows an automobile in the proper position for the distribution of traffic, leaving plenty of room for the passing of traffic coming up behind.

The entire contract consists of 53,000 ft., divided as follows: Macadam center with concrete shoulders, Stas. 0 to 71, 166 to 288, 308 to 332, 382 to 530, and 20-ft. concrete roadway on the intermediate sections, as the old surface was not considered worth saving.

Convict labor from the House of Correction is used for the common work, and is paid at the rate of $2.50 per nine-hour day. Each gang is accompanied by a guard supplied by the superintendent of the penitentiary, and conveyances are furnished to carry the men to and from the work.

Labor-saving machinery is used for the rough grading. Fig. 2 shows a traction engine hauling a road machine for grading on the sections to be paved with concrete full width. It is necessary first to break the surface with a scarifier. The fine grading is done by hand, and the subgrade is rolled with a 10-ton roller. On the excavation for the concrete shoulder work the contractor tried to use a small short-blade grading machine, but found that it did not work satisfactorily. He found it necessary to plow and dig the side trenches by hand labor. On this narrow work hand tamping is used to compact the subgrade.

All materials for the work are furnished by the state, being delivered at the nearest railroad siding, from which point the contractor loads and transports them to the job. The equipment for hauling materials consists of one 2-ton and two 5-ton motor trucks, with which the necessary stone, sand and cement are transported. In the case of the shoulder work, the sand and stone are dumped in uniformly spaced piles along the opposite side of the road from the construction, while they are dumped upon the subgrade in the 20-ft. and 10-ft. strips.

Concrete stone of the No. 2 size is used. It is limestone bought by the state in the open market, but coming from quarries within the state. In the delivery of these materials upon the subgrade, the sand and stone are placed in alternate piles, from which they can be

FIG. 3. CONCRETE MIXER BUILDS ONE SIDE AT A TIME

conveniently wheeled to the mixer. The concrete for both the 20-ft. section and the shoulder work is mixed in the proportions of 1 : 2 : 4.

On the shoulder construction, a ½-yd. concrete mixer is being used. This is operated upon the surface of the old road, and the concrete is poured directly into the steel forms. Fig. 3 shows this mixer in operation. When the forms are filled with a concrete of proper consistency, it is struck off with a short board float which consists of a 2 x 6-in. plank 4 ft. long laid flat upon the forms, with handles for operation. The concrete roller shown in the illustration is used only where

FIG. 4. COMPLETED SECTION OF SHOULDER BEFORE THE BITUMINOUS CONNECTION WITH ROAD IS LAID

excess water makes it advisable to compact the concrete. The small float which can be seen lying on the form gives a surface similar to that on a cement sidewalk. Fig. 4 shows a completed section of shoulder with the concrete mixer standing in the distance. The forms are of steel, 650 ft. being used to build this narrow section.

A force of 18 men is used for the shoulder work. Of these, 14 are convicts. The gang is made up as follows: Two stone wheelers, one sand wheeler, five shovelers, one cement wheeler, one cement feeder, three finishers, two form setters, one water boy, one mixer engineer and one foreman. This gang could build about 500 ft. of shoulders in a nine-hour day.

Fig. 5 shows a completed section at the crown of a hill covered with earthy material for curing; note the fine condition of the old treated-macadam surface, which had been worn away at the edges.

The itemized cost of building 2367 sq.yd. of shoulder is shown in Table I, the total cost per square yard being $3.24. Common labor was $3.60 and convict labor $2.50 per nine-hour day.

Wherever possible, the 20-ft. pavement is built in one section, but as detours are impracticable in most places, a large portion of it is being built in the 10-ft. sections, which are called for in the original contract. These sections are 8 in. thick at the center of the road and 6 in. at the edge, making an average thickness of 7 in., and are tied together with ⅝-in. rods 3 ft. long. The

TABLE I—COST OF BUILDING 2367 SQUARE YARDS OF THREE-FOOT CONCRETE SHOULDERS FOR MACADAM ROAD

Labor

Item	Cost Total	Cost Per Sq. Yd.
Excavation	$800.00	$0.338
Unloading and hauling materials	900.00	0.380
Mixing, placing forms, curing and protection	2000.00	0.845
Total manipulation	$3700.00	$1.563
Materials		
Sand, 360 tons at $1.30 (Cost of material 60c. and freight 70c.)	$468.00	
Stone, 570 tons at $2.10 (Cost of material $1.30 and freight 80c.)	1197.00	
Cement, 780 bbl. at $2.84	2215.20	
Demurrage, rentals, etc.	100.00	
Total, materials	$3980.20	1.681
Total cost	$7680.20	$3.244

rods are expected to control the joint along the center of the road, and while it may not be possible to prevent hair-cracking, it is thought that the rods will prevent vertical displacement of the two sections of slab with respect to each other.

The equipment for concreting the wide section con-

FIG. 5. SHOULDER PROTECTED BY EARTH COVERING

sists of a ¾-yd. mixer and about 600 ft. of steel forms. An ordinary strike-board is used for the concrete, and the finishing is done by the roller-and-belt method. The gang employed for this work is 28 men, of whom 21 are convicts. It is made up as follows: Six wheelers, ten shovelers, three men handling cement, two cement finishers, three form men, one engineer, two mixer men and one foreman. This gang has averaged about 400 ft. of 10-ft. pavement per nine-hour day. Practically the same force is used when the 20-ft. single slab is built, and the gang averages about 250 ft. per day, or equal to 500 ft. of 10-ft. slab.

Separate costs for 10-ft. and 20-ft. widths are not available, but Table II shows the cost on 20,800 sq.yd., of which about one-half was built in 10-ft. sections. As the amounts of each type of construction were equal, and as the amount of yardage laid per day varies as 500 to 400, an approximate relative cost can be obtained by proportion. About 25% more yardage of 20-ft. slab was laid per day than of 10-ft., using the same gang. The average unit cost of mixing, placing and curing, which, it will be assumed, was the only part of the total unit cost affected by the difference in width, was $0.433, as seen from Table II. Let x and y equal this part of the unit cost for the 10-ft. and 20-ft. strips, respectively.

Then $\frac{x+y}{2} = 0.433$, and as $x = 1.25\ y$, $x = 0.481$ and $y = 0.385$. If these are substituted for 0.433 in Table II, the cost of the 10-ft. strip was $2.703 per square yard, and the cost of the 20-ft. strip was $2.607 per square yard.

It will be noticed that the cost of the narrow shoulder strip is more per unit than for the 10-ft. section of the 20-ft. strip, while at the same time the 10-ft. sections

TABLE II—COST OF 20,800 SQUARE YARDS OF CONCRETE ROAD, ONE-HALF BUILT IN 10-FOOT SECTIONS

Labor

Item	Cost Total	Cost Per Sq. Yd.
Excavation	$5000.00	$0.240
Unloading, hauling and rehandling materials	7050.00	0.339
Mixing and placing concrete	9000.00	0.433
Total manipulation	$21,050.00	$1.012
Materials		
Sand, 3000 tons at $1.30 (Material 60c. and freight 70c.)	$3900.00	
Stone, 5500 tons at $2.10 (Material $1.30 and freight 80c.)	11,550.00	
Cement, 6100 bbl. at $2.84	17,324.00	
Demurrage, steel, rentals, etc.	1400.00	
Total materials	$34,174.00	1.643
Total cost	$55,224.00	$2.655

cost more than the single 20-ft. strip. This is as would be expected when the extra moving of equipment is considered.

The contract is a Federal-aid project, being done under the supervision of the Maryland State Roads Commission, of which Frank H. Zouck is chairman, and J. N. Mackall is chief engineer. E. H. Wroe is the engineer directly in charge. Thomas, Bennett & Hunter, of Westminster, Md., are the contractors. It is hoped that this road will be completed in time to carry the heavy motor-truck traffic that is expected in the coming winter.

Youngstown Sanitary District Proposed

Owing to the pollution of the Mahoning River all the way from Warren, Ohio, to the Pennsylvania state line, and various peculiar conditions involved which cannot be dealt with by the various communities singly, the Ohio State Department of Health has advised the formation of a sanitary district. The department expects to draft a bill for introduction in the legislature and to submit the draft to a conference of representatives of the municipalities concerned. The Mahoning River is grossly polluted by sewage and industrial waste, and at times receives so much water used for cooling purposes as to make the temperature of the water extreme abnormally high. All this, the department states, makes the river unsatisfactory as a source of water-supply for either municipal or industrial use. During low water, it adds, a decided nuisance arises. Dr. Allen W. Freeman is commissioner of health of Ohio; James E. Bauman, deputy commissioner; and W. A. Dittoe, chief engineer.

Comparison of Excavation Haulage by Motor Trucks, Industrial Railways and Teams

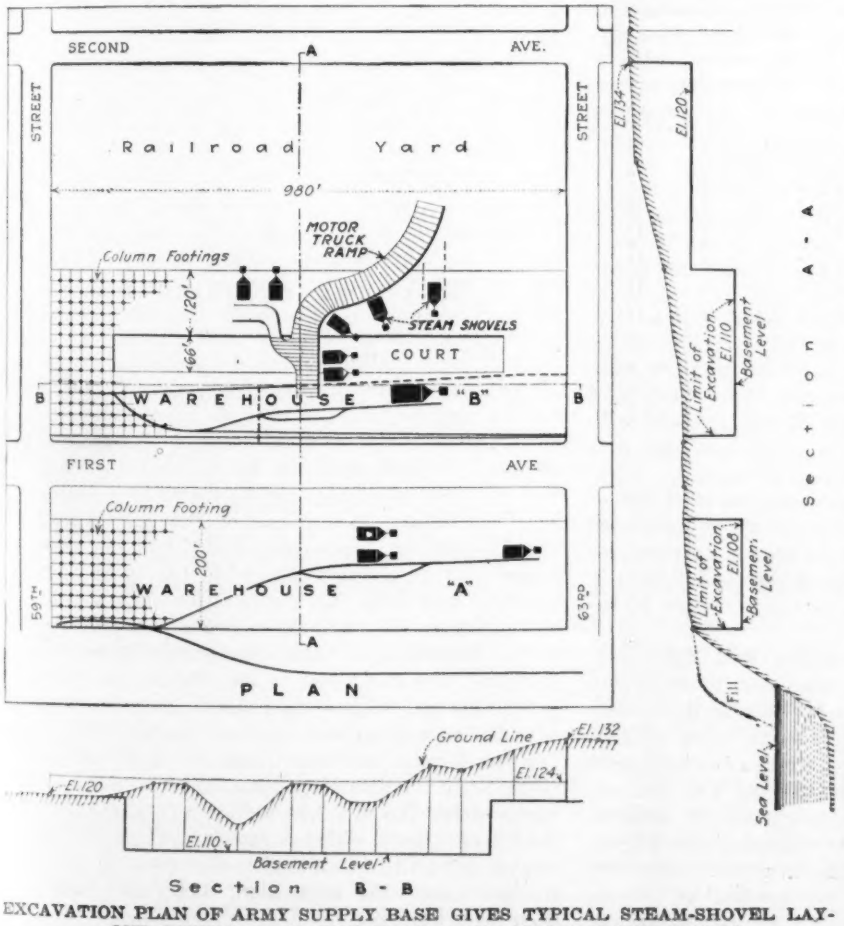
Detailed Cost Accounts on the Construction of the Brooklyn Army Supply Base Show That Trucks Are More Economical Than Teams and Less Economical But More Flexible Than Railways

OPPORTUNITY for comparing various methods of hauling excavated material to the dump is offered by the construction nearing completion at the Army supply base, South Brooklyn, N. Y. The three common methods of conveyance—teams, trucks, and industrial railways—are being used, and the amount of material handled is believed to supply sufficient data from which to form conclusions. The cost tables for this job show that trucks are much cheaper per ton-mile than teams, even for short hauls, but are somewhat more expensive than industrial railways for the long hauls. For short hauls the trucks are cheaper than the railways. Motor trucks are said to have the added advantage that they are more flexible and can go to any desired dump, while conditions such as traveling over city streets and up heavy grades make the industrial railway in some cases impracticable.

The South Brooklyn Army supply base is one of the large Government-owned shipping points built to facilitate the forwarding of supplies to the troops abroad. It is situated on the waterfront between 58th and 63rd Sts., extending two blocks back from the waterfront to Second Ave. The buildings, an excavation plan for which is shown in the illustration, consist of the usual docking facilities and two large warehouses. Warehouse A, west of First Ave., will be 200 ft. wide by 980 ft. long. Warehouse B, east of the avenue, will be 306 ft. wide by 980 ft. long, with a court 740 x 66 ft. through the center. The former has eight stories and a basement; the latter has nine stories above the dock-floor level.

As originally planned, Warehouse B was to have had twice the plan area of that built, but after the excavation was well started a basement was added and the size of the building was decreased. When the two warehouses are completed the floor space will be about 4,400,000 sq.ft. The total cost of the base is estimated at a little more than $30,000,000, a cut of about $14,000 000 from the original estimate.

Excavation started May 15 under the cantonment type of contract for emergency work, and construction has continued night and day with few interruptions. The estimated amount of excavation is 650,000 cu.yd., of which 494,558 had been moved up to Sept. 18. The general contractor let the excavation by subcontract—the subcontractor to furnish all labor, equipment and supervision, and to be paid a rental for his plant and a commission not to exceed a fixed sum on the payroll and supplies. Although the cutting is heavy, the work could not be carried on to advantage as in a large excavation contract. The urgency of the construction required that all work should go on at the same time. Form building, piledriving and concreting had to follow closely behind the excavation, and arrangements had to be made which would accommodate all operations. Another feature tending to add to the difficulty of excavation was the change of plan soon after work started. Warehouse B, the dimensions of which were altered, originally required 10,000 piles, according to the



EXCAVATION PLAN OF ARMY SUPPLY BASE GIVES TYPICAL STEAM-SHOVEL LAYOUT, SHOWING RAILWAY TRACKS AND MOTOR-TRUCK RAMPS

plans. When the basement was added it was supposed that the extra depth would give a sufficiently compacted soil, so that the bearing power of the column footings would be sufficient without the piles. However, soon after work began, it was found that an old ravine which had been filled had soft material at the bottom, and that sufficient bearing power could not be obtained without going below the water level in the bay. In part of Warehouse A, a large concrete mat was used instead of the piles, to expedite the work.

Much of the excavated material was old fill, which extended to varying depths over the entire site. The character of the material was quite general, containing all manner of débris, such as tin, wire, old barrel hoops and cans, all interwoven and having a tendency to clog the teeth of the steam shovels. The natural earth encountered was loam and plain sand. Reference to the plan and cross-section shows that the depth of cut varied considerably, the average being about 18 ft. Although the difficulties of excavation were greatly increased by the changes in plans and addition of basements, this portion of the construction, as all others, was completed ahead of the schedule originally proposed.

Eleven steam shovels were used on the work. A description of them and their performance from the start to July 3 is shown in Table I. The diagram shows the direction in which the various shovels worked in Warehouses A and B; the large 2½-yd. shovel cleaned out the

TABLE I. EARTH EXCAVATION PERFORMANCE, SOUTH BROOKLYN ARMY BASE, FOR THREE WEEKS ENDING JULY 3, 1918

Description				Excavation		
Shovels	Make	Size of Bucket, Cu. Yd.	Type	Amount Cu. Yd.	Cost	Cost per Cu. Yd., Cents
1	Marion	1½	41	22,354	$2,660.22	12
2	Thew	¾	A1 Revolving	13,904	2,071.09	15
3	Osgood	¾	18 Revolving	12,670	1,764.23	14
4	Bucyrus	¾	18B Revolving	11,570	2,150.98	19
5	Thew	¾	A1 Revolving	14,240	2,220.92	16
6	Marion	1½	40	16,410	2,765.07	17
7	Marion	1½	40	17,555	3,351.53	19
8	Marion	2½	60	34,308	2,836.85	8
9	Thew	¾	A1 Revolving	12,000	1,934.95	16
10	Marion	1	31 Revolving	12,670	2,057.76	16
11	Bucyrus	¾	14B Revolving	16,930	2,154.42	13
Total				184,611	$25,968.02	Ave. 14

southwest corner of Warehouse B, while the others were distributed in various positions over the work. Most of the material from Warehouse B was removed with motor trucks, which drove out from the hole over planked ramps having a grade of about 6%. When grades of more than 6% were used, the efficiency of the trucks fell off sharply. Four-inch plank were used for the ramps, which were built as near to an even surface as possible, since it was found that undulations in the grade had a marked effect on the operation of the trucks.

An industrial railway, with eighty 4-yd. dump cars and eight 10-ton locomotives, was used to carry the earth away from the large shovel. Because it was necessary to enter the basement excavation on an inclined track, it was impossible to use a storage track of more than 10 cars capacity without interfering with the concreting of the footings. Transportation of material from Warehouse A was by teams and industrial railway, both of which delivered the material at the waterfront adjacent to the building. The average haul at the site was about ¼ mile. No planking was provided where teams were used, and as the soil was sandy the load which could be hauled was cut down to an average of three-quarters of a cubic yard.

Three dumps were utilized for the disposal of excavated material, and, while much material was used for filling and backfilling at the site, the greater part had to be hauled quite a distance. Most of that hauled by motor trucks was transported to a dump at Dyker Park, where the city is filling up a low, mosquito-infested marsh for a park along the waterfront. This dump is located 3.2 miles from the construction, making the round trip 6.4 miles. The route passes over paved streets for the entire distance, and the only places where planking was necessary was at the shovels and on the dump.

Planking a Large Item

Planking is one of the large items in the expense of truck-excavation transportation, and it was particularly so at this dump on account of the marshy conditions involved. At times the drive along the edge of the dump would settle as much as 4 ft., requiring a complete readjustment of the plank. These settlements were the result of the forcing out of the underlying soil by the overburden of earth; a mud wave that was sometimes 4 ft. in height stretched along in front of the fill.

The dump used by the industrial railway for such material as was not disposed of at the site was near Fort Hamilton. But for the speed required in disposal, it would have been possible to haul all the material away in 4-yd. dump cars on narrow-gage track, but the single-track equipment could not handle the output of the 11 steam shovels required to complete the excavation on schedule. The Fort Hamilton dump is three miles distant from the construction. The material was used to fill in low ground between the harbor line and the shore. The usual difficulties in keeping track in shape when dumping into water were experienced on this fill.

Distribution of the excavation, transportation and disposal costs by the three different methods and to the various dumps, from the start on May 15 to Sept. 18, when about 75% of the entire excavation was completed, is shown in Table II. The distribution covers pay roll, plant rental, supplies and a commission of 6%; no commission, however, was computed on plant rental. In obtaining the total unit cost, the transportation, excavation, disposal and overhead are kept separately. Thus, to obtain the total unit cost for excavation, transportation and disposal of material by teams at the site, it is necessary to take the team cost of 32.4 plus the level cost of 27.2 plus the dump cost of 20.6 plus the overhead charge of 11.9, giving a total of 92.1c. In like manner, the total unit costs for trucks and railways disposing at the site are 106.6 and 96.5c., respectively. In the case of the long-distance hauling to Dyker Park and Fort Hamilton, the dump cost is included in the total unit cost in the last column; this makes it necessary to add only the excavation and overhead charge, which gives total unit costs for these items of 175.6 and 133.5c., respectively. Inasmuch as the average haul for these items varies, the only just method of comparison is on the ton-mile basis, which is shown in Table III. In the last mentioned table, all that is considered is the actual transportation—the excavation, dump cost and overhead being omitted.

Besides the cost of haulage per cubic yard and per

TABLE II. DISTRIBUTION OF EXCAVATION, TRANSPORTATION AND DISPOSAL COSTS FOR EARTH, SOUTH BROOKLYN ARMY SUPPLY BASE, FROM START, MAY 15, TO SEPT. 18, 1918

Item	Quantity Cu.Yd.	Pay Roll — Amount	Pay Roll — Unit Cost, Cents	Plant Rental — Amount	Plant Rental — Unit Cost, Cents	Supplies — Amount	Supplies — Unit Cost, Cents	Commission at **6%	Totals Plus Commission	Total Unit Cost Cents
Excavation										
*Shovel gangs	494,558	$72,702.59	14.7	18,981.50	3.8	36,561.93	7.4	6,555.87	134,801.89	27.2
Transportation and Disposal:										
To site by teams	80,230	24,517.00	30.5	0.00	0.0	0.00	0.0	1,471.02	25,988.02	32.4
To site by trucks	24,490	10,833.00	44.2	0.00	0.0	0.00	0.0	649.98	11,482.98	46.9
To site by industrial railway cars	37,258	7,578.00	20.4	2,079.00	5.5	3,400.00	9.1	658.68	13,715.68	36.8
*Site dump costs	141,978	27,659.00	19.5	0.00	0.0	0.00	0.0	1,659.54	29,318.54	20.6
To Dyker Park	185,352									
Transportation labor	.....	17,176.44	9.3	0.00	0.0	16,139.00	8.7	.....	.....	.....
Trucks	.....	175,620.00	94.7	0.00	0.0	0.00	0.0	.....	.....	.....
* Dump cost	.....	29,795.60	16.0	0.00	0.0	0.00	0.0	.....	.....	.....
Total	.....	222,592.04	120.0	0.00	0.0	16,139.00	8.7	14,323.86	253,054.90	136.5
To Fort Hamilton by Industrial Railway	167,228									
Train operation	.....	41,526.97	24.8	19,415.57	11.6	29,731.29	17.7	.....	.....	.....
Track gang	.....	18,654.63	11.1	915.94	0.6	3,223.10	2.0	.....	.....	.....
* Dump cost	.....	36,549.41	21.9	0.00	0.0	0.00	0.0	.....	.....	.....
Total	.....	96,731.01	57.8	20,331.51	12.2	32,954.39	19.7	7,781.12	157,798.03	94.4
Overhead:										
* Field Office	494,558	13,027.82	2.6	1,149.99	0.2	1,344.65	0.3	.....	.....	.....
*Field supervision	.....	17,354.37	3.5	0.00	0.0	0.00	0.0	.....	.....	.....
*Moving plant	.....	19,891.91	4.0	2,111.92	0.4	958.00	0.2	.....	.....	.....
Total	.....	50,274.10	10.2	3,261.91	0.6	2,302.65	0.5	3,154.61	58,993.27	11.9
Grand total	.....	512,886.74	103.7	44,653.92	9.0	91,357.97	18.5	36,254.68	685,153.31	138.5

* Not included in transportation costs as shown in Table III.
** Commission was not allowed upon plant rental.

ton-mile, Table III shows the excavation transportation performance of the various types of hauling conveyances. The total number of 10-hour shifts, the number of trips per 10-hour shift, the distance to the dump, the mileage traversed per 10-hour shift, the average load, the average amount carried per unit per shift, and the total amount moved by each type of conveyance, are shown. As the yardages given are place measurements, and as a great amount of the material was sand and very damp, the weight per cubic yard taken for figuring the cost per ton-mile was 1½ tons. Considering the cost of haulage by teams disposing at the site, the total tonnage hauled would be 80,230 × 1½ = 120,345, and this multiplied by 0.25 mile equals 30,086 ton-miles. Dividing this into $24,517, the total cost of haulage by teams, gives a cost per ton-mile of 81.4c. By the same course of reasoning the other ton-mile costs were found.

Further consideration of Table III shows that even for short hauls, down to ½ mile, the motor truck was more economical than either teams or the industrial railway. If teams had been used to transport the material to Dyker Park, it is seen from the table that the difference in favor of the trucks would have been still more marked. Assuming that on account of planking a load of 1½ cu.yd. could be carried, and assuming that a team would make three trips per day, or a distance of 19.2 miles, a team would transport 3 × 1½ × 1½ × 3.2 = 21.6 ton-miles per 10-hour day. This divided into $9, the prevailing rate per day, would give a ton-mile cost of 41c., which does not include the cost of planking as assumed above. Therefore, the cost of hauling by teams would probably be more than double that by trucks, which was 23.5 cents.

For the long hauls the data show that the industrial railway was 8c. cheaper per ton-mile than trucks on this particular job, but when the only other variable, the dump cost, is considered, the difference is not so great. It will be seen from Table II that the dump cost for the cars was about 4c. per ton higher than for the trucks. The advantage in using the trucks lay in their adaptability and the speed with which they could handle the material. The only limit to the amount of material which could be handled in a given time was the number of trucks that could be passed under the steam shovels and loaded. In the case of the industrial railway with single track and passing track, the limit was determined by the number of trains that could be switched and passed. The work has been carried on in two 10-hour shifts, but careful records have shown no difference in the amount of work accomplished, with the same equipment, as between day and night work.

The work is being done by the Construction Division of the Army. Brig. Gen. R. C. Marshall, Jr., is chief of the Construction Division, Lieut. Col. H. S. Crocker is constructing quartermaster, and Maj. J. W. Cerny,

TABLE III—EXCAVATION, TRANSPORTATION PERFORMANCE AND COST, SOUTH BROOKLYN ARMY SUPPLY BASE, FROM START, MAY 15, TO SEPT. 18, 1918

Equipment and Destination	Unit 10-Hr. Shifts Worked	Average No. Trips per Unit per 10-Hr. Shift	Average Distance Traversed per Round Trip, Miles	Average Miles per Unit per 10-Hr. Shift	Average Load per Unit Cu.Yd.	Average Amt. Per Shift per Unit, Cu.Yd.	Total Amount Moved, Cu.Yd.	Cost of Haulage per Cu.Yd.	Cost of Haulage per Ton Mile	*Total Cost of Haulage
Teams, disposing at site	2,751.0	39.5	0.5	19.75	0.74	29.2	80,230	$0.305	$0.814	$24,517.00
Auto trucks, disposing at site	383.7	20.3	1.0	20.3	3.14	63.8	24,490	0.442	0.590	10,833.00
Industrial railways, disposing at site	1,064.5	10.0	0.6	6.0	3.5	35.0	37,258	0.350	0.779	13,057.00
Auto trucks to Dyker Park	5,774.1	9.0	6.4	57.6	3.57	32.1	185,352	1.127	0.235	208,935.44
Industrial railway cars to Fort Hamilton	11,308.5	4.0	6.0	24.0	3.7	14.8	167,228	0.678	0.151	113,467.50
Totals							494,558	.....	.....	$370,809.94

* Figures do not include excavation or dump costs or overhead charges.

Quartermaster Corps, Natonal Army, is directly in charge of the part of the work described. The general contractor is the Turner Construction Co., New York City, of which A. C. Tozzer is executive manager, and the subcontractor for the excavation is Rodgers & Haggerty, of New York City.

City Plat Disapproved Because Not Suited to Topography

RECENTLY the plat of a new real-estate development was submitted for approval to the plat commission of Ramsey County, Minnesota, in which the city of St. Paul is situated. The commission refused to approve the plat, on the ground that the layout was not suited to the topography. In consequence, the question has been referred by the city council to the new city planning board.

All subdivisions in the city of St. Paul must be approved by the commission named, which consists of four members, one of whom is commissioner of public works and serves ex officio.

In the past the board has confined its jurisdiction largely to seeing that streets matched with territory already platted and that mortgage liens had been released in so far as they related to the dedication of streets and alleys, and to making sure that proper maps and records were prepared and filed. The present action is an important extension of the work of the board into a new field.

A subdivision of 27 acres fronting on the Mississippi River Boulevard was submitted for approval. There were already several developments and proposed developments in that neighborhood, in the nature of homesteads of from one to twenty acres. The proposed plat consisted of lots 40 or 50 ft. in width, with streets cut through as extensions of present streets. On account of the topography, the new streets would require heavy grading and considerable cutting of property. The commission declined to accept the plat, asserting that it was an improper development of the district and that the streets were not properly laid out as regards the topography.

Under the ordinance passed last March creating the city planning board, it has jurisdiction over "all matters concerning or relating to the platting of new areas." The case of the disapproved plat was referred to the board's committee on plats and street plans. This committee not only upheld the objections of the plat commission, but went further and submitted a definite plan and location of the streets. The report of this subcommittee has not yet been acted upon by the city planning board as a whole. In the meantime the owners are selling lots by metes and bounds in defiance of the city authorities.

Ford Car Cleans Water-Works Reservoir at Trenton, N. J.

BY W. COMPTON WILLS
Assistant Engineer of Distribution, Water Department, Wilmington, Del.

THE successful use of a Ford motor car in cleaning a 35,000,000-gal. reservoir at Wilmington, Del., has once again opened a new line of work for this machine.

The removal of sediment to an average depth of 8 in. from the reservoir was necessary, as concrete baffle walls are to be constructed to lengthen the period of retention of the raw water stored in the reservoir. Water for moving the sediment by hose-flushing was not available.

A Ford service car was lowered into the reservoir and attached by ropes to a plank drag 8 ft. long with side extensions 2 ft. high, and provided with four handles.

The automobile pulled the load slowly over the drain inlet, after having been loaded by two laborers directing the drag through the mud. Then three laborers stationed at the drain inlet guided the drag and kept the space about the inlet clean. It was possible to keep the car continually on the move, circling back and forth between the loading point and the drain. As the men worked away from the drain inlet the mud was dragged to water in the reservoir bottom, and carried in suspension by the water to the sewer.

Allowing $13 per day for running cost, depreciation of car and wages of the driver, also labor cost of $22.50 per day, both items totaling $35.50 per day, and a removal of 300 yd. of sediment per day, we have a rate of about 11⅞c. per yard near the sewer. As we cleaned away from the sewer and dragged to the stream of water, four extra men were used to puddle the material so the stream could carry it away. This increased the unit cost to 19½c. per yard. About 4000 cu.yd. were carried out in some 14 working days. Overhead charges for placing and removing the car, hauling men back and forth to the site, furnishing brooms and drags, and handling valves, etc., have not been included in the figures given herewith.

FORD CAR USED TO CLEAN RESERVOIR AT TRENTON

Salesmen of Engineering Equipment for Export Must Be Engineers

Must Introduce Not Only American Machinery but American Methods—Showing Economics of Use Most Important Factor

By S. T. Henry

Vice President, Allied Construction Machinery Corporation

(An address before the Technical Publicity Association, New York, Nov. 15, 1918)

LARGE and permanent export markets for standard American engineering machinery can be built up abroad by the introduction of American methods of using such machinery.

The introduction abroad of American industrial methods was a slow and tedious process, until recently. Several large American manufacturers had, however, conducted such introductory work with marked success. They had sent into various countries of the world sales engineers who were well grounded in the use of their machinery. While these engineers went as salesmen, their work was to educate the engineers and the industrial men of other countries regarding American methods. They had to show these prospective customers why our way was the cheaper way. They had to prove that the use of our standard machines would produce results more quickly and economically than special machinery. These men worked under great handicaps. But they made good. They demonstrated that it was then highly practicable to sell standard American machinery, instead of merely taking orders that were offered for special machines.

Governing Conditions Greatly Changed

In the past two or three years conditions have changed completely. The world has learned more in that time about American engineering machinery and American engineering methods than could have been forced upon it in a generation through the most strenuous commercial efforts. Engineers from everywhere know the wonderful results our forces have achieved in building, equipping and operating port works, railways, highways and machine shops in France. The world is ready now to adopt American industrial methods and wants to be educated in our way of doing engineering work.

If the opportunity is handled rightly, no limitations of the trade possibilities thus presented need be considered. The thing is to put the work in the hands of men who are thoroughly schooled in American methods of using American machinery. It goes without saying that these men must have commercial sense. They must know how to deal with other business men. But, above all, they must have the "know how" of what they are trying to introduce. They must be able to sell ideas, not merely to take machinery orders.

A few examples may illustrate how engineer-salesmen of such qualifications work. These examples also will indicate the type of men required to introduce American engineering methods and to sell the standard American machinery used in following such methods.

Take the largest American manufacturer of mining machinery; *this* concern and its predecessors consistently have followed for a generation a policy of using engineer-salesmen abroad. The company has branch offices or agencies in all of the countries in the world where mining and quarrying are done on any considerable scale. In each of these branches or agencies there is located one or more engineers who have had considerable experience in American methods of mining and quarrying.

These men are actually selling drill holes in the rock and tons of ore in the car, instead of rock drills and compressors. When a new proposition comes up they help to study the conditions to be met and advise what equipment is best suited to these conditions. In the case of existing works they must go right in and prove how American machinery and American methods will save money, as compared with what is being used. When up against cheap peon labor in Mexico, for example, it is not easy to get a native mine owner to substitute an expensive mechanical plant for plentiful hand labor. He must be shown that the cost per ton of ore brought to the surface is less with such a plant.

Work of this kind is too deep water for a commercial salesman who can readily switch from shoes to millinery. It requires men who know from experience what the customer wants to know. Men of these qualifications become practically a part of their customers' organization.

Here is another case. American saw-mill machinery is used quite extensively in a far eastern country, as a result of the work of a single American engineer-salesman. This man knew thoroughly American methods of cutting timber, handling logs and running sawmills. When he went to this country a few years ago he was totally unfamiliar with the language. He went out and lived among the timber operators, and learned their language, their customs and their conditions. He did not meet the peculiar demands of the local lumbermen for machinery. Instead, he showed them how American methods could cut more and better lumber for them at less cost. These American methods required standard American machinery.

Engineer-Salesmen Essential to Success

Whenever you find an American sales engineer, trained for work in foreign fields, you will find him introducing American methods, as illustrated by these examples. At home you will find that the executives who have had experience with men of this caliber are convinced what overseas policy they must follow to get results. The ordinary commercial salesman simply will not do. The engineer-salesman, of proper qualifications, is almost assured of success in realizing on the opportunities that are presented in foreign markets to American engineering machinery manufacturers.

Scarcity of the right kind of men is the one big problem in adopting a sales engineering policy in export marketing. So many qualifications are desirable that an enumeration of them would appear to reduce the candidates to a very few. Just as in domestic work, however, it rarely is possible to find a man who matches up completely to the requirements of the job.

It is comparatively easy to find men who are thoroughly grounded in American methods of using any line of engineering machinery. When these men are sorted on the basis of ability to deal with business men, the percentage of rejections is large. Those who do pass

this test are nearly all eliminated when considered as to their commercial sense. This does not necessarily apply to their commercial experience, but rather to their ability to sense a commercial situation.

The few candidates who are left when these few simple tests have been applied would nearly all be discarded on account of a lack of knowledge of any foreign languages. Frequently it is necessary, therefore, to overlook this very essential qualification and to send out to a foreign country a man who must learn the language after he arrives. Any man who goes out thus handicapped is bound to have to work under very great difficulty. Experience gained by a number of American engineering machinery manufacturers has demonstrated, however, that such a handicap is far less serious than a lack of knowledge of American methods of using the machinery to be marketed.

This conclusion is heresy in the minds of most people experienced in regular commercial export trade. Right here it is well to draw a very definite line between the marketing abroad of commodities and articles of ordinary commerce and the sale of engineering machinery. In the one case it is unquestionably necessary to adapt the commodity or article to the needs of the country. For example, it is impracticable to attempt to substitute an American hatchet for a Cuban machete. It is likewise necessary for a salesman of shoes to know the whims of the average man and woman of the country in which he is trying to do business. But antiquated industrial and engineering methods are much the same the world over. When the operations affected are sufficiently large to justify the use of machinery, instead of hand labor, the work is nearly always in charge of men who can understand engineering arguments. These arguments are the same everywhere. It certainly is a handicap not to be able to present them in the language of the men to whom an engineer-salesman must talk. It is a far greater handicap, however, not to know what the arguments are.

Engineers Lack Business Qualifications

The lack of business qualifications in most American engineers is a sad reflection on the work of our engineering schools. It is a fact, however, that the courses in these schools tend to give most of the young men who take them an entirely wrong viewpoint of the commercial side of engineering. Our technical societies also have overstressed the ethical side to such an extent that an engineer who has anything to do with business loses more or less of his professional standing. This seems strange in light of the fact that engineering is, after all, a matter of dollars and cents. Such an attitude on the part of engineers toward business is probably a relic of the old days of pure-science education. Whatever the cause may be, the time has arrived when our engineering schools and our engineering societies will either have to get a new viewpoint regarding commercial affairs, or fail to produce the engineer-salesmen whom American industry needs so greatly.

Many suggestions have been made as to what courses our technical schools should give. One suggestion in regard to the foreign-language work required of engineer students may not be amiss here. It would seem that these courses could be given in a practical way. Young engineers should study a language as it is studied by men who must have it for commercial use abroad. Most important of all, the student should be thoroughly convinced in advance of the value of the language to him. With some practical plan in place of the kind of language study now given, one of the chief handicaps of engineer-salesmen abroad would soon be eliminated.

Returning from these things as they might be to things as they are, the average American manufacturer may want to know how he can adopt the plan of using American engineer-salesmen to sell his products abroad. This has been done in a good many ways, in each of which there have been some successes and some failures.

For the large manufacturer, the problem is comparatively simple. He can afford to establish his own branch offices in the more important centers of the world. He can also afford to supply his own trained men to coöperate with agencies in other centers of less importance. In the still more limited centers he can have his trained engineers on call to help local connections, scattered over a considerable area, to develop leads for business.

Three Methods of Procedure Open

The manufacturer having a more limited output has three principal opportunities open to him, under present conditions: He can turn his export sales over to one or more general export commission houses with branch offices in the countries in which he desires to operate. He can join with a group of noncompeting manufacturers in similar lines, coöperating in order to reach the foreign markets in which these manufacturers are interested. He can bring together a group of his competitors under the Webb-Pomerene law to form an organization that will go after export business for all of them. The best plan to be adopted by any manufacturer can be determined only after very careful study of what he wants to accomplish, the markets to be reached, and his own limitations.

Some general export commission merchants have been quite successful in introducing and marketing American engineering machinery abroad. These concerns are of sufficient size to justify them in maintaining engineering-sales departments. These departments, to all intents and purposes, are separate machinery houses which utilize the experience and the facilities of the organizations of which they are a part.

Unfortunately, the number of general export commission houses so organized is very limited. Those general export concerns which attempt to market engineering machinery as they do ordinary commodities make some sales. They cannot, in the nature of things, build any business.

Coöperative export engineering-sales organizations developed by a group of noncompeting manufacturers in allied lines are a comparatively new idea. Such coöperative concerns, properly conceived, organized and financed, apparently offer to the average engineering machinery manufacturer one of his best opportunities.

In the first place, such an organization insures each manufacturer of the benefit of thinking of all of the manufacturers in the group. This collective thinking eliminates many of the difficulties which individual manufacturers would encounter. This plan permits the

group to maintain properly trained engineer-salesmen on salary in practically all of the centers of the world where there are opportunities for the use of the particular general line of machinery involved. This means that each member of the group has good representation in many places where the member could not afford to have a salesman call even occasionally. Many of the other advantages of the plan can be appreciated only by actual experience in its working.

Just how combinations of competitors under the Webb-Pomerene law will work in the engineering machinery field remains to be seen. Thus far no such combination has been undertaken. In certain lines of commodities and of quite standard products there are undoubtedly advantages to be gained through operation under this law. The difficulties apparently are such, however, that no group of competing manufacturers of engineering machinery has seen its way clear to attempt to get together for a combined effort to market their product outside of the United States.

Whatever plan is adopted by the American engineering machinery manufacturer in his export sales work, he can build a large and permanent market only by introducing American methods of using his machinery. Such introduction can be made properly only by experienced American engineer-salesmen.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Conservation Applied to Municipal Engineering Problems

Sir—The need for the conservation of both time and material is one of the many problems which the war has brought home to the American people. Confining myself to the municipal field, I wish to call particular attention to the time and money required because of the inaccuracy and in many cases the utter lack of records of municipal engineering projects in the offices of many city engineers, and to suggest a way of preventing or lessening this lack in the future.

It seems to be a reflection upon the engineering profession, to reply to a taxpayer inquiring about a sewer or a water line built only a few years ago in front of his property, that it will be necessary to send a gang of men and dig it up before he can get information which should be forthcoming in a couple of minutes. A similar lack of records often causes more serious trouble, attended with possible loss of property and life and with certain expense. For instance, the writer once had to shut off about 5000 persons from the use of water, including fire protection, for a period of several days, because no record had been provided by a predecessor for use in locating valves which had to be shut before it was possible to replace a broken main. In another case which has come under the writer's observation, improvements and extensions to existing sewer and water mains are costing from one-third to one-half more than they would cost were proper records available regarding the location of sewer Y's, water valves, etc. The main reason for such conditions is the employment of incompetent men as engineers.

Most city authorities are not in a position to audit their engineers' records, nor does there now exist an agency to which cities can apply for such aid. Most cities hire a man whom they consider a good engineer, as they employ a competent clerk or treasurer, but they place the latter under heavy bonds and have their accounts audited by certified public accountants periodically, in order to assure the safety of their funds. Meanwhile, the city engineer expends thousands, or perhaps hundreds of thousands, of dollars without check.

To remedy this deplorable condition, the writer would suggest the creation of a state board of municipal engineers whose sole duty would be to visit the office of each city engineer in the state, either at regular intervals or upon proper summons, for the purpose of investigating and reporting to the city authorities the exact state of affairs.

CLARENCE E. RIDLEY,
Port Arthur, Tex. City Engineer.

Nation-Wide Legislation to Establish Bridge Loadings Needed

Sir—I have read your editorial on p. 878, issue of Nov. 14, with much interest, and suggest a matter which should be discussed at the Chicago convention—a matter which involves many millions of dollars; the loading for which highway bridges should be designed.

At present some states fix this loading by statute and some leave it to their engineers. This is good, but statutes are easily amended, and engineers die or resign and are succeeded by others with different ideas. The subject is a nation-wide one, and the loading should be established by uniform legislation throughout the country because many heavy trucks in the future will cross state lines. It is easy to specify an extravagant loading, but it is not so easy to pay for the bridges and other structures that will be necessary to carry it.

Economy will be the watchword, but it is not economy to restrict unduly the weights of transportation over the public roads. It should, of course, be borne in mind that whatever limits may be imposed by law on the weights to be transported on public roads, any concern, whether manufacturer, truck owner, street-railway company, quarry owner or other party, has a right to have public bridges built to carry any traffic he wishes to take over it, providing he will bear the additional expense it involves; the purpose of the proposed statute being to fix public liability, rather than to limit public transportation.

WILLIS WHITED,
Bridge Engineer, Pennsylvania Highway Department.
Harrisburg, Penn.

Number of Engineering Graduates

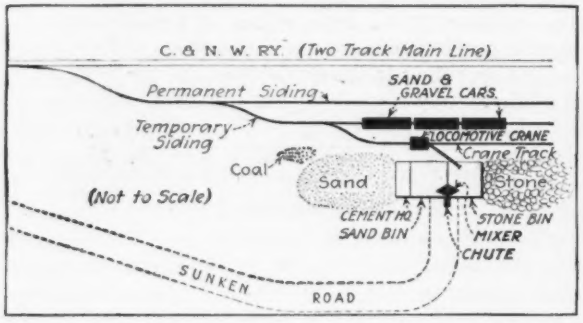
Civil engineering graduates from 1895 to 1916, inclusive, numbered 11,621; electricals, 6357; mechanicals, 11,291; miners, 3195; chemicals, 1172; general engineering 1897; metallurgical, 150; marine, 15; textile, 48; agricultural, 31; total, 35,777. These figures are from the United States Bureau of Education Circular No. 4, Aug. 30, 1917. The total number of graduates in engineering in 1895 was 752 and in 1916 4306. Students in 1916 numbered 33,106.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

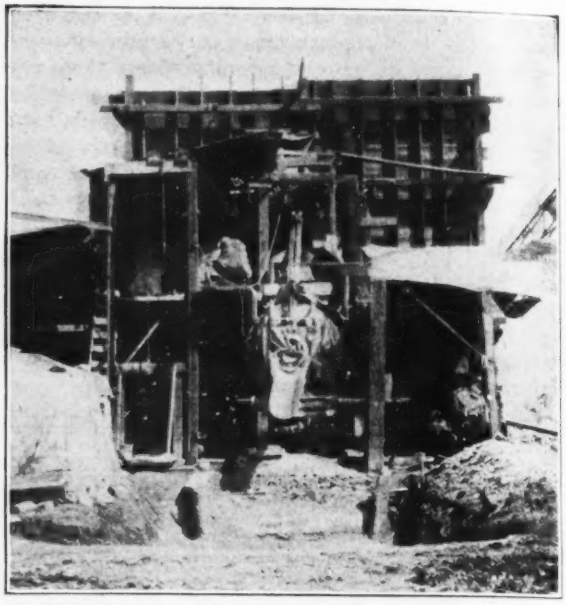
Motor Trucks Deliver Mixed Concrete Three-Fourths of a Mile

HAULING from a central mixing plant, four motor trucks have delivered 13,400 cu.yd. of concrete for pavement base at Edison Park, Ill. Base was laid on 5.7 miles of street. It was 24 ft. wide and 6 in. thick, of 1:3:6 gravel concrete. To cut down haulage and economize on labor, it was decided to install a mixing plant close to the point of delivery by railway of materials, and to haul the mixed concrete. This plan also kept the streets clear of material piles and mixing plants.



MANUAL LABOR LAYING PAVEMENT BASE REDUCED BY CENTRAL UNLOADING AND MIXING PLANT

Temporary switches, as shown by the sketch, were led off the station siding, and a mixing plant was built alongside. This plant consisted of two elevated bins side by side, each holding 50 cu.yd. At one end of the bin structure was a ground-level cement house. The mixer sat under the bins on the side away from the tracks. An ordinary paving mixer was installed by blocking the wheels, jacking up the frame and replacing the elevating skip with a high-level charging hopper into which the bin chutes led. Cement bags were hoisted to the charging platform in an elevator cage operated by the mixer engine, as described in *Engineering News-Record* of Nov. 21, p. 956. The bins were charged by locomotive cranes from cars on the stockpiles, as indicated by the sketch plan.



MOTOR TRUCKS BACK UNDER MIXER CHUTE TO RECEIVE FOUR BATCH LOADS

The average output of concrete per day was 305 cu.yd., the maximum day's run was 380 cu.yd. Operating the mixing plant was a crew of 13 men, distributed as follows: One mixer operator, one crane operator, two firemen, two car men, one dumper, five cement men and one handy man. The mixer discharged directly into trucks backed into the depressed roadway under the chute. Each truck received four batches, making a 2-cu.yd. load. It then ran to the work and dumped the concrete onto the subgrade. The average haul was ¾ mile and the maximum haul was one mile; the average time of haul was 14 min., and the maximum time of haul was 20 minutes.

LOCOMOTIVE CRANE HANDLES SAND AND GRAVEL

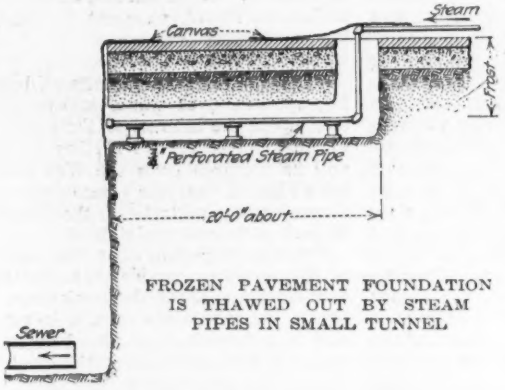
On the street the concrete was handled by a gang consisting of four shovelers, three broomers, two dumpmen, two graders and one stakeman.

The concrete was delivered without material leakage, and presented a good appearance both when it was spread and after hardening. The contractors for doing the Edison Park work were B. F. Conway & Co., Chicago, Ill.

Steam Pipes in Tunnel Under Frozen Pavement Aid Excavation

By C. H. Cotten
Lieutenant, Corps of Civil Engineers, United States Navy

IN BUILDING a large intercepting sewer through a paved street in very cold weather, considerable difficulty was encountered in breaking up the concrete base of the brick pavement, on account of 18 in. of frost



FROZEN PAVEMENT FOUNDATION IS THAWED OUT BY STEAM PIPES IN SMALL TUNNEL

underneath. This trouble was greatly reduced by digging a hole 3 ft. in diameter on the line of the trench about 20 ft. ahead of the section already excavated, and then tunneling between this hole and the excavated section.

Perforated steam pipes were placed in the tunnel, as shown in sketch, and hooked to the boiler of the excavating machine. Old canvas was used to cover the holes to retain heat in the tunnel. Steam turned into the tunnel for a few hours caused all the frozen earth to loosen up and fall from the under side of the concrete. The base could then be broken up with very little trouble.

Long-Handled Steam Shovel Digs and Fills Trench in 50-Foot Sections

TRENCH for a 7000-ft. sewer in Cleveland, Ohio, is being excavated and backfilled, at the rate of 50 ft. a day, by a single steam shovel. The shovel digs a short length of trench, the pipe is laid in the cut, and then the shovel, loading from a spoil bank, backfills the cut. Continuous repetition of this operation constructs the sewer, and only one piece of major equipment is required for the work. A trench 3 ft. wide and 15 ft. deep is being dug in hard clay overlying shale which has to be blasted. The shovel has a 30-ft. dipper handle; working five hours a day it is taking out 83 cu.yd., or 50 ft., of trench, and after

SHOVEL WITH 30-FOOT DIPPER HANDLES ALTERNATELY TRENCHES AND BACKFILLS

the two lines of pipe are laid it is backfilling the cut. The contractors, Randall & Cooper, Lorain, Ohio, estimate that the shovel replaces 30 laborers.

Construction Photographs Should Give Definite Information

By Rudolph T. Roesch
Thompson & Binger, Inc., Engineers and Contractors, Syracuse, N. Y.

CONSTRUCTION photographs, if they are presented in good form, are the records which interest clients most. A photograph which does not tell its own story is of little value. This may be how the site looks before work is begun, how work is progressing, how good the workmanship is, why progress is delayed, extra work that had to be done, special features of structure or construction plant—or, perhaps, faulty work—but there should always be a story.

Progress photographs are of most importance. Two vantage or observation points should be carefully chosen before work begins. Always take the photographs from these points, as progress is thereby emphasized. Different days, not less than two a week, should be designated, and on these days, weather permitting, one photograph should be taken from each vantage point.

Detail photographs will depend upon the subjects which present themselves for record. Suggested subjects are: Placing and handling material; exceptional and unusual formwork or concrete work; unusual structural features; finished work of various kinds, night work, special equipment, and ornamental details.

In addition to progress and detail photographs it is advisable to record extra work, conditions which hinder progress, faulty or defective work, and accidents. All photographs should be titled and dated. When the work is completed, those photographs which mean something, which show progress or excellent work, should be mounted in a small album. *Then use the album.*

NEWS OF THE WEEK

New York, November 28, 1918

American Reconstruction Conference Discusses Federal and Municipal Problems

National Planning, Housing, Garden Cities and Public Employment Among Topics at Rochester Meeting

Called before the armistice was signed to urge the need of Federal studies of reconstruction, the conference held by the National Municipal League at Rochester, N. Y., Nov. 20-22 was finally devoted chiefly to consideration of the lessons to be learned from unified national control in war time.

Besides the platform, several resolutions were adopted. One of these directed the president of the league to appoint a committee to promote local or community reconstruction activities, this committee to be provided with a full-time secretary. Other resolutions advocated the extension of municipal home rule, and provided for a committee to study public ownership and for a committee to coöperate with the United States Bureau of Standards in its "investigation into numerous technical problems of direct interest to municipalities, especially in the field of public utilities."

Relations of Government to Industry

In opening a discussion on the new relations of the Federal Government to industry and to state and local governments, Prof. H. L. McBain, Columbia University, said he thought the courts would hold legal a Peace Industries Board. He thought that Congress could legally authorize Federal acquisition of railroads, telegraphs and telephones under the post office and post roads portion of the constitution and that the Government could also legally acquire sources of industry—if it has the power to acquire forest lands, as it has already been doing. Government regulation of capital and labor seems almost inevitable, the speaker said, but as regards industries, control will be directed chiefly against evils rather than the industries themselves. One principle which labor would indorse and capital oppose is collective bargaining. Nothing strikingly new was expected by the speaker as regards the relation of the Federal to state and local government, except more coöperation.

A session devoted to "Replanning the United States in Regard to Transportation, Housing and Public Works" was opened by F. L. Ackerman of the Emergency Fleet Corporation. The taking over of the railroads by the United States, said the speaker, has shown that they were planned and built for no common or national purpose, but for speculation and for the development of territory. Terminal problems were neglected and at the opening of the war inland water transportation was almost dead. In not a single community where shipbuilding was taken up by the Government was there found a satisfactory forward-looking program to help in meeting the housing problems of shipbuilders.

Today the needs of ports and terminals and of agricultural areas to supply them can be forecast, Mr. Ackerman said. Why not plan accordingly? he asked, and said that if a plan be designed for the United States, then there should be one for the states, and if for the states, then for the cities. In the speaker's opinion such planning must be designed to satisfy the higher needs of industrial workers. There is nothing in their present surroundings to breed aught but discontent. In any industrial city which has developed rapidly the accumulated capital is not reflected in the environment of the workmen. Instead, we see ugly industrial buildings and ill planned cities or districts. "Garden cities" should be the ideal.

National planning must include regional planning and rural development, Mr. Ackerman contended. This requires the extension of the administrative work of the Government and the liberalizing of judicial decisions.

Street Railway Situation

The street railway situation was discussed at length by Delos F. Wilcox. Opening his remarks with the statement that his views were personal, he said that the present crisis was precipitated by the war, but that its origin lies far back in the "five-cent fare as a basis for speculation." The present problem is to get rid of over-capitalization. It is no longer possible to continue to pay dividends on ancient investments in mules and cable railways—which investments should have been written off long ago. In the larger cities, particularly where heavy investments have been made for subways and like facilities, municipal subsidies may be necessary if low fares are to be continued. The public is more interested in good service than in low fares. It

(Concluded on page 1005)

All Restrictions on Non-War Building Removed

War Industries Board Announces That No Licenses of Any Sort Will Now Be Required

Since Nov. 21 no licenses of any sort have been required for new construction. This removes the last restriction on building, of those started early in the war. For ten days after the signing of the armistice prospective builders were required to get permits for non-war construction from state Councils of Defense. B. M. Baruch, of the War Industries Board, gave out the following statement regarding the latest ruling:

"The action taken permits all building operations of whatever character, held up in the interest of the war program, to proceed. No further permits will be required from the War Industries Board or the state councils, through whom control over the situation in each state was maintained.

"Immediately following the signing of the armistice on Nov. 11, the non-war construction section took steps to loosen the restraints on the industry, and in a formal order issued that day removed a great many of the barriers. Since then, and with a view to assisting the industry back to a complete peace basis as quickly as possible, a careful canvass has been made to determine whether the conditions obtaining in each state with respect to building materials, transportation, and the supply of fuel and labor would warrant a removal of the remaining restrictions. In this investigation the nonwar construction section sought the views of the industry itself and of the state Councils of Defense. The replies received, coming from practically all the states, showed a unanimous opinion in favor of such action."

Power Bills Probably All Dead

All of the emergency power bills and both of the water-power bills before the present Congress will in all probability be discarded, according to advices from Washington. The power bills were the so-called "war emergency power" acts, the first for $200,000,000 and the substitute for $50,000,000, which money was to have been utilized in the construction of new power plants and additions to old plants, mostly steam-driven, in the war-industry districts. The water-power bills, one of which had passed the House and the other the Senate, were in conference. They provided means for developing water-power on the public lands of the United States.

Hold Seven-Day Conference On Motor Transportation

Truck Owners Expect Boom for Industry—Practically Every Phase of Problem Discussed

A seven-day conference which started Nov. 16 under the auspices of the Colt-Stratton Co., New York, had for its object the dissemination of knowledge of vital interest to truck operators. Subjects of both local and national interest were discussed, and the speakers were unanimous in prophesying great developments in highway transportation.

Adaptations of the motor vehicle to the uses of modern warfare, rural express, store-door delivery, and intercity freight haulage, were described by prominent speakers. Economic problems, comprised under "Methods and Devices for Increasing Motor Haulage Efficiency," "Highway and Street Improvements" and "The Traffic Problem" were also discussed. A feature of the program was the showing of a film depicting the manufacture and exploits of tanks in France.

ADVANCE IN MOTOR USE DURING WAR

At the opening meeting, J. R. Eustis, of the Colt-Stratton Co. explained the purposes of the meeting and reviewed the great advance made in motor transport during the war. He stated that the United States has invested in motorized equipment for the Army to the amount of $500,000,000, and now has upward of 70,000 motor trucks in France and 30,000 more either on the way or contracted for. The motor truck has shown its adaption to every form of Army transportation, and motorized ice-machines, machine shops, water distillers, hospitals and airplane transports are now in use. In one operation the American Army transported a division of 38,000 men 116 miles in 16 hours to close the St. Mihiel salient, according to the speaker. Maj. George E. Greene, of the British Army Tank Service, made the statement that in 18 months of service he had not seen a single instance of the motor truck being out of commission from mechanical difficulties.

Monday evening was given over to the consideration of rural express and rural mail, the speakers being T. W. Fenn, executive secretary of the National Automobile Chamber of Commerce, and James I. Blakeslee, fourth assistant postmaster general. On Wednesday evening store-door delivery was the subject. It was discussed by Joseph Husson, editor of the *Commercial Vehicle*, and Arthur A. McKeever of the Ajax Trucking Co. Intercity freight delivery was the subject on Thursday evening, and the speakers were E. F. Foejambe, of the *Commercial Car Journal*, the Hon. Cyrus C. Miller, director of transportation of the Federal Food Administration, and others. All the speakers emphasized

(Concluded on page 1004)

General Contractors Complete Organization

Over 165 Firms and 25 Associations Represented at First Annual Convention

Coördinated organization was the keynote of the convention last week at which final steps were taken to create the Associated General Contractors of America. Organization was urged, to the end that the contractors of America, like the other great business interests of the country, may present a united front in dealing with the problems which construction and reconstruction present to engineering.

Prominent speakers at the convention, including John F. O'Rourke, engineer and contractor; Brig. Gen. R. C. Marshall, Jr., chief of the construction division, United States War Department; Col. W. A. Starrett, chairman of the committee on emergency construction of the War Industries Board, and Harry A. Wheeler, president of the Chamber of Commerce of the United States, made the dual thought of organization and coördination the theme of their remarks. Three principal tasks, in the view of these speakers, confronted the association. First is the adjustment of the contractor's relations with labor, based on a broad recognition of labor's right to a voice in determining the principles and processes of industrial development; second is the adopting of a construction contract which shall fairly divide responsibilities and risks and assure a fair compensation for work honestly and efficiently done. General Marshall indorsed this thought when he said: "Time has passed when between the four corners of a sheet of paper may be written the words which will consign a contractor to bankruptcy." The third great task of the association is to coördinate the owner, the engineer and the contractor into a trinity having as its single purpose economic construction and the common good.

EXPERIENCES IN VARIOUS CITIES TOLD

The convention opened with an experience meeting. Secretaries of local contractors' associations of Chicago, Detroit, Memphis and New York told what organization had accomplished in their respective communities. The cost of conducting business has been lowered; the morale of the industry has been bettered; a finer *esprit de corps* has been created; recognition of contracting as one of the units of the business life of the community has been enforced, and more sound relations with owners and workmen have been established.

The constitution finally adopted was quite different from the committee's draft published in *Engineering News-Record* of Oct. 3, p. 620. The articles of most immediate interest to contractors are those relating to membership and to dues. The qualifications for membership follow:

"Sec. 1. Only general contractors, either individuals, firms or corporations, who have been engaged for at least two years in general contracting prior to applying for membership in this association, or who have established a reputation for skill, honesty and responsibility, shall be eligible for membership. They must also undertake work in its entirety, partly at least with their own constructing forces.

"Sec. 2. Members of the association must be associated organizations of general contractors, individuals, firms or corporations engaged in general contracting. Only such members of associated organizations as fulfill the above requirements shall have voting representation in this association."

FIXING OF DUES

As presented by the committee the article on dues read: "Dues of the association shall be, for each individual, firm or corporation $50 annually. Dues for associated organizations shall be $10 annually for each voting member of such organization, with a minimum for each associated organization of $100 per year." Discussion on this article was active and assumed two sides. The argument of a part of the members was that extended membership was the first need, and dues should be small enough to accelerate increase in membership. On the other side the contention was made that money was needed, and needed at once, to prosecute the work of the association, and only by high dues could this money be obtained. As finally passed, the article read: "Dues of the association shall be, for each individual, firm or corporation, $100 annually."

The election of officers resulted as follows: President, D. A. Garber, New York; first vice-president, W. A. Rogers, Chicago; second vice-president, T. T. Flagler, Atlanta, Ga.; third vice-president, John W. Cowper, Buffalo; treasurer, C. F. Mullen, Cleveland. The constitution provides that the secretary shall be named by the executive board.

Delegation of American Engineers To Visit France

At the invitation of the Société des Ingénieurs Civils and a committee of the French Engineers' Congress, and with the official approval of the French Government, a delegation of American engineers has been appointed to study with French engineers certain problems involved in the rehabilitation of France after the war. This delegation was invited to come to Paris to examine in joint conference questions of the utilization of commercial ports, the development of navigable waterways, the development of water power, and the improvement of road systems. Although these were the only subjects mentioned specifically, the congress will probably take up many other ques-

tions of development in which all engineers are directly interested. The invitation was sent to the American Society of Civil Engineers and was accepted at once by cable, the acceptance stating that such a delegation would be organized in coöperation with the other American national societies.

The following delegates have been appointed:

By the American Society of Civil Engineers—J. F. Case, chairman; George W. Tillson, George W. Fuller, A. M. Hunt, Nelson P. Lewis, and George F. Swain.

By the American Society of Mechanical Engineers—Charles T. Main, president.

By the American Institute of Electrical Engineers—Lewis B. Stillwell.

By the American Institute of Mining Engineers—E. Gybbon Spilsbury.

The date of sailing was originally set for Dec. 2, but it may be postponed a few days. The trip as planned will take about six weeks.

Motor Transport Conference

(Concluded from page 1003)

the great advantage to the public of utilizing these three new means of transportation and regulation.

Store-door delivery would decrease the cost of foodstuffs in New York City greatly, according to Mr. Husson. He brought out the fact that a bushel of potatoes can be delivered in New York for 70c., but the delivery charges at this end raise the cost to the consumer to $2.10. Mr. McKeever stated that freight congestion had extended as far as St. Louis, and that freight had to be returned to Chicago from New York for warehousing on account of the congested condition in New York.

The development of intercity haulage to 300 miles for less than carload lots was stated to be the field of the motor truck by Mr. Foejambe. Trucks with two drivers, having a sleeping compartment back of the seat for the use of one while the other drives, are now in service. One great advantage in this development of the motor truck is the elimination of terminal congestion by going from store door to store door.

Highways and their relation to motor-truck transportation were discussed by Prof. Arthur H. Blanchard, of Columbia University. Of the 2,500,000 miles of rural roads in the United States 0.25% are suitable for motor trucks, according to Professor Blanchard, who gave a general review of the highway situation. H. G. Sherley, of the Highway Industries Association, treated the highway problem from a national point of view, urging the desirability of national regulatory laws and increased national aid in highway construction.

These who desire a résumé of the proceedings of the conference can obtain one from the promoters, the Colt-Stratton Co., 1847 Broadway, New York City, who announce that similar conferences will be held semi-annually.

New Firm Organized by Dwight P. Robinson

Engineering and Construction Company with Headquarters in New York to Cover Wide Field

Dwight P. Robinson, a former partner of Stone & Webster, in charge of their construction and engineering business, has opened offices in New York under the name of Dwight P. Robinson & Co., Inc., constructing and consulting engineers. Associated with him will be R. M. Henderson, in charge of construction; C. W. E. Clarke, mechanical engineer; R. A. Philip and D. L. Galusha, electrical engineers, and M. E. Thomas, structural engineer, together with the nucleus of a strong purchasing, accounting and field construction organization. All of these men, for many years, have been engaged in large undertakings under Mr. Robinson's direction.

In the past they have specialized in the economical and rapid execution of difficult projects, and in the new work are prepared to construct, either from their own designs or from the designs of others, hydro-electric developments, steam-power plants, transmission systems, industrial plants, housing developments, steel and reinforced-concrete structures, the electrification of steam-railway systems, and similar work in this general field. They will also carry on a general practice as consulting engineers, including the making of engineering and financial reports and appraisals.

In these fields the members of the organization have had extensive experience, both individually and collectively. Mr. Robinson's work runs back for a period of 25 years, during which he has been associated with Stone & Webster, first in the management of some of their electric railway and lighting properties, later, for 15 years, as president of the construction and engineering branch of the organization. Since 1912 he has been a member of the firm.

While he acted in this capacity all of Stone & Webster's construction and engineering activities came under his personal supervision. Some of the more generally known projects were the extensive water-power developments serving the Puget Sound cities, the steam and water-power plants supplying Minneapolis, the electrical and transmission features of the Keokuk development on the Mississippi, the Big Creek development serving Los Angeles, and others in various parts of the East and South; large steam-power stations for Buffalo, Boston, Minneapolis, New Bedford, Youngstown and other smaller plants, aggregating over 500,000 kilowatts capacity; a wide range of industrial buildings, from simple warehouses and factories to monumental structures such as the new home of the Massachusetts Institute of Technology; housing developments, including complete towns with paving, sidewalks and all utilities. Mr. Robinson is a graduate of Harvard University and the Massachusetts Institute of Technology.

Mr. Henderson will, for the present, have charge of construction. He was with the Stone & Webster organization 12 years, seven as assistant construction manager at Boston, and three as district manager at Chicago. His earlier experience as industrial engineer on the staff of the Arnold Co., Chicago, and as electrical engineer of the Mexican Central Ry., was in both the design and the construction of railway locomotive and car shop plants and other industrial plants, including such projects as the principal shops of the Mexican Central Ry. at Aguascalientes, the Big Four Ry. shops at Beech Grove, Ind., and those of the Missouri Pacific Ry. at Sedalia, Mo. He was chiefly instrumental in the internal development of the construction department of Stone & Webster, and later had direct charge of a wide range of steam, hydraulic, industrial and building construction, including reinforced-concrete structures of many types. He is 39 years old and a graduate of the Armour Institute of Technology.

Mr. Clarke, for seven years with Stone & Webster, five as mechanical engineer and head of the division, has had a long and varied experience in the design of central power stations, and mechanical engineering in industrial plants.

Mr. Galusha has been working under Mr. Robinson's direction for 12 years, the past five as head of the electrical division. His experience also covers a long list of power stations and industrial plants in all sections of the country. Some of his best known work was done as electrical engineer in charge of the Mississippi River power development at Keokuk, and the Minneapolis General Electric Co.'s large steam station, replacing one destroyed by fire.

Mr. Thomas, who will have charge of structural design, has been engaged in a similar capacity with Stone & Webster for nine years. His work has covered the layout and design of industrial factories and plants, including the buildings and the structural features of steam and hydro-electric plants. His specialty has been in reinforced-concrete design, and, with C. E. Nichols, he is a co-author of "Reinforced-Concrete Design Tables." Some of the noteworthy concrete structures which have come under his direction are the monumental superstructure of the power station surmounting the dam on the Mississippi River at Keokuk, the concrete structural work of the new buildings of the Massachusetts Institute of Technology, the concrete buildings of the field and siege gun carriage plant at the Rock Island arsenal, and the less pretentious but larger brick and steel group at the Watertown arsenal. The numerous steel unit warehouse buildings and shop build-

ings which were fabricated in America and shipped to France for the American ordnance base depot back of the fighting line, as described in *Engineering News-Record* of Jan. 3, 1918, p. 23, were designed by Mr. Thomas. He is 35 years old and a graduate of the University of Illinois.

Mr. Philip's association with Mr. Robinson began 18 years ago, when he was electrical engineer of the Seattle Electric Co., which was then under the management of Mr. Robinson.

War work at various arsenals, cantonments, ordnance bases, and on other direct and indirect war plants in this country and France, has occupied these men from the beginning of the war until the need of such work has passed. They form the nucleus of an extensive staff whose development will keep pace with the activity of the reconstruction period. Adequate financial resources and connections assure the company's ability to handle operations of any magnitude.

American Reconstruction Meeting

(Concluded from page 1002)

is easier to insure good service, the speaker said, by municipal ownership and operation than through municipal or state control.

The broad subject of "Public Employment," including employees of both the Government and the public utilities, was presented by Charles A. Beard of the New York Bureau of Municipal Research. With the present Federal control of railway, telegraph and telephone facilities there are now some 4,000,000 Federal employees. The public must be educated to the necessity for trained and expert public servants, railway administrators, engineers, chemists, bacteriologists and others. Civil service commissions must be transformed into public employment agencies, charged not with turning rascals out but with getting and keeping efficient men into public service. The right of public employees to organize for other than social or beneficial purposes, and also the right to deal directly with the Government through committees and to strike, is, in the opinion of the speaker, sure to come with the increase in the number of public employees.

Federal housing was the subject of addresses by Ernest Cawcroft of the Emergency Fleet Corporation and of Richard S. Childs, New York City. These men and other speakers were enthusiastic over the achievements of Federal housing at some of the permanent cities or villages which have been developed along the "garden city" line. Mr. Childs expressed the hope that these examples of good housing and of good town planning would react upon not only the industrial workers who live in these houses, but also upon the country at large. The satisfactory appearance of some of these groups of houses is due not so much to the architect as to the town planner. A single one of these very simple houses looks bare, but a village of them properly grouped is charming. Particular reference was made to Buckman Village, near Chester, Penn., and to Perry Village, Md. Mr. Childs urged that the bureau of industrial housing in the Department of Labor should be continued, and suggested that a revolving fund might be provided for housing purposes, similar to the revolving fund of the United States Reclamation Service.

Concrete Freighter "Faith" Completes 12,000-Mile Voyage

On Nov. 21 the reinforced-concrete ship "Faith," which was launched in San Francisco last March, reached New York after a voyage in which stops were made at Vancouver, Lima, New Orleans and Havana, and totaled about 12,000 miles. On Nov. 25 she was put in dry dock at the Erie Basin in Brooklyn. So far as could be seen in an examination of the outside of the shell and bottom by a member of the staff of *Engineering News-Record* immediately after the docking, there are no cracks in the hull, nor is there any sign of rusting from lightly embedded steel. There was some slight marine growth, but in general the hull was remarkably clean. Examination of the inside of the shell is not readily made, because the wooden sheathing is fastened to the frames, but the holds were quite dry, and the shell, where it could be observed, showed no cracking. The ship encountered very heavy weather throughout the voyage, but handled well.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York City; Dec. 3-6, New York.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston; Dec. 9, Chicago.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; A. Dennis Williams, Morgantown, W. Va., acting secretary; Dec. 9-13, Chicago.

AMERICAN ROAD BUILDERS' ASSOCIATION; 150 Nassau St., New York City; Feb. 25-28, New York City.

The Western Society of Engineers has made the following nominations for office for 1919, through the nominating committee: President, A. S. Baldwin; vice-presidents, Kempster B. Miller, William M. Kinney, J. L. Hecht, treasurer, C. R. Dart. This is the first set of nominations made under the revised constitution of the society; the names are selected by a nominating committee appointed by the board of directors. Other nominations may be made, up to Dec. 20, by petition of 20 members.

The Municipal Engineers' Society of the City of New York held a meeting Nov. 25 at which Harry M. Devoe, deputy superintendent of school buildings, New York City, delivered a paper on "Repairs and Maintenance of Public School Buildings and Equipment in the City of New York." The date of the December meeting has been changed to Dec. 23.

The Albany Society of Civil Engineers was addressed at a meeting Nov. 26 by George F. Thompson, Lockport, N. Y., who spoke on "Hydro-electric Power." A nominating committee was chosen to select candidates for officers for the coming year.

The Engineers' Club of Trenton elected the following officers at the meeting held Nov. 14: President, Charles R. Fairchild; first vice-president, Alfred P. S. Bellis, and secretary, Joseph E. English.

The National Drainage Congress will hold its seventh annual meeting at Chicago Dec. 13. Edmund T. Perkins, Chicago, is chairman of the central cooperative committee in charge of the arrangements for the meeting.

The Engineers' Club of Philadelphia will be addressed by Dr. Lightner Witmer, Department of Psychology, University of Pennsylvania, at the weekly luncheon to be held Dec. 3.

PERSONAL NOTES

G. C. THAYER, formerly of the Cramp shipyard, Philadelphia, has been appointed general manager, Merchant Shipbuilding Corporation, Bristol, Penn., succeeding W. T. Smith.

C. W. STARK has resigned as associate editor of *Engineering News-Record* to go with the New York-New Jersey Port and Harbor Commission. His work will be to assemble in report form the data collected by the engineering forces of the commission. Mr. Stark was graduated from Harvard University in 1903, and entered railroad work in the maintenance-of-way department of the Baltimore & Ohio R.R. at Chicago. A year and a half later he entered the engineering department of the New York Central R.R., where he remained for five years, serving as draftsman, assistant engineer, and assistant to the engineer of grade crossings. His last year with the New York Central was spent in the general designing department. For

a year previous to his joining the staff of *Engineering Record*, five years ago, he was with the engineering department of the Central Railroad of New Jersey. His work on the staff of this journal has been largely in the railroad field, specializing in track elevation, terminals and valuation.

J. T. WILSON, district engineer, Baltimore & Ohio R.R., with headquarters at Baltimore, has been appointed consulting engineer, Baltimore & Ohio Lines East, Wheeling Terminal R.R., Western Maryland Ry., Cumberland Valley Ry. and Cumberland & Pennsylvania Railroad.

R. W. MCKINSTRY, who recently completed two years' service in France and Belgium, has been elected county engineer of Skagit County, Washington. He was a member of the 72nd Seaforth Highlanders and is a veteran of Vimy Ridge. Mr. McKinstry served three terms as engineer of Goodhue County, Minnesota.

ALBERT J. CHANDLER has been appointed chief engineer, Nevada Northern Ry. on account of the extension of leave of absence granted to P. R. Boese, formerly chief engineer, now serving with the Canadian engineering forces.

RICHARD MATHER, district engineer, Baltimore & Ohio R.R., with headquarters at Huntington, W. Va., has been appointed district engineer with headquarters at Baltimore, succeeding J. T. Wilson, who has become consulting engineer of the Baltimore & Ohio Lines East, as noted eleswhere.

MAX DIETENBECK has resigned as assistant engineer, Kansas City, Mexico & Orient R.R., and has become assistant engineer in the valuation department, Chicago, Burlington & Quincy R.R., with headquarters at Chicago.

CAPT. SAMUEL W. FLEMING, JR., of Gannett, Seelye & Fleming, consulting engineers, Harrisburg, Penn., is now a major.

C. S. HERITAGE, bridge engineer, Kansas City Southern Ry., with office at Kansas City, Mo., has been appointed also bridge engineer of the Missouri & North Arkansas Railroad.

A. C. CLARKE has been appointed district engineer, Baltimore & Ohio R.R., with headquarters at Huntington, W. Va., succeeding Richard Mather, appointed district engineer with headquarters at Baltimore, as noted elsewhere.

A. S. ZINN resigned recently as designing engineer, Air Nitrates Corporation, New York City, to enter the office of the chief engineer, Missouri Pacific R.R., at St. Louis. Mr. Zinn was resident engineer, central division, Panama Canal, from 1906 to 1914, afterward serving as consulting engineer for the Republic of Panama.

V. V. KIRKPATRICK, assistant division engineer, Kansas City Southern Ry., has become valuation engineer, Missouri & North Arkansas R.R., with office at Kansas City, Mo.

LIEUT. J. H. H. MUIRHEAD, British Royal Engineers, is now on duty in this country as a lecturer with the British Bureau of Information.

H. J. ARMSTRONG, engineer maintenance of way, Missouri & North Arkansas R.R., has been appointed division engineer, with headquarters at Harrison, Ark.

I. A. COTTINGHAM, chief engineer, Southern Pacific Terminal Co. and Galveston Wharf Co., was recently appointed chief engineer of all Galveston railroad terminals.

R. E. VAN ATTA, principal assistant engineer, Kansas City Southern Ry., with headquarters at Kansas City, Mo., has been appointed also principal assistant engineer of the Missouri & North Arkansas Railroad.

OBITUARY

CAPT. HUGH MITCHELL PRICE, United States Engineers, died Nov. 4 in the embarkation hospital at Newport News, Va. He was born at Bloomington, Ill., and was graduated in civil engineering from the University of Illinois in 1903. After some professional experience in Oklahoma and Texas he went to Chicago, where he was, at one time, with W. S. Shields, sanitary engineer. Later he entered practice as a civil and sanitary engineer. When the war broke out he offered himself for military duty, and also volunteered for service as a civilian engineer. After being in Washington for some time in the latter capacity, he was sent to the Pig Point Ordnance Depot, near Hampton, Va., where he was construction engineer and afterwards chief engineer. In September, 1917, he received his commission as captain, but continued in charge of the work he had begun as a civilian. In August, 1918, he met with a motor-car accident, which was not considered serious at the time, but his injuries developed an illness which caused his death.

LIEUT. HAMILTON R. CLARK, United States Engineers, died of pneumonia in France, Oct. 1, at the age of 24. His home was in Stapleton, Staten Island, New York. Lieut. Clark had served in the 71st Regiment of New York, and on his arrival in France was transferred from the New York Division to the 305th Engineers.

DR. CHARLES R. VAN HISE, president of the University of Wisconsin, died in Milwaukee Nov. 19. He was born in Fulton, Wis., in 1857 and was graduated from the University of Wisconsin in 1879 with the degree of B. S., and in 1880 received the degree of M. S. In 1882 he was made a doctor of philosophy. From 1878 to 1883 he was instructor in metallurgy at the University of Wisconsin, and from 1883 to 1886 he was assistant professor of metallurgy, later becoming professor of mineralogy and professor of geology. He became president of the university in 1903. In 1909 he served as chairman of the Wisconsin State Conservation Commission. From 1908 to 1915 he was chairman of the board of arbitration in the controversy between the Eastern railroads and the Brotherhood of Locomotive Engineers. Among his works are "The Conservation of the Natural Resources of the United States" and "Concentration and Control—A Solution of the Trust Problem in the United States." He was also joint author of works on the iron-bearing regions of Michigan and Lake Superior.

PHILIP W. BRADY, who served in the San Francisco city engineering department continuously from 1864 to 1906, died in that city, Nov. 15, at the age of 76. After the fire of 1906 Mr. Brady's knowledge of the surveys of the city made his services invaluable in the restoration of the true positions and alignment of corners and street lines.

LOUIS BLACKSTONE, division engineer of the Philadelphia & Reading Ry. for 29 years, died recently. He was born in Connellsville, Penn., in 1849, and was graduated from Bethany College in 1870. He entered the employ of the Allegheny Valley R.R. as a member of the engineer corps. In 1878 he was made supervisor of the Pennsylvania R.R., and in 1889 he was appointed to the post he occupied when he died.

F. C. DE GUERRE, previously of the city engineer's office, North Vancouver, B. C., and later with the engineering staff of the Granby Consolidated Power Co., died recently in Vancouver.

CHARLES ERHARDT, acting chief engineer, Citizens' Water Supply Co., Newtown, L. I., died in Long Island City, Nov. 23, at the age of 38.

W. A. COWAN, superintendent of the western lines of the Canadian Government railways, died at Cochrane, Ont., Nov. 19, at the age of 40. He was also chief engineer of the district, and had three divisions in his charge.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Priority Ratings May Still Be Obtained

Certificates Will Be Granted Only When Need Is Urgent and in the Public Interest

Although existing priority ratings, with few exceptions, have all been revoked, it is yet possible to obtain rulings on urgent public business. Orders included in circular No. 58 of the priorities division, War Industries Board, dated Nov. 20, 1918, supersede all previous orders, revoke former rulings and explain exceptions.

After Nov. 22, 1918, all rules and regulations heretofore promulgated by the Priorities Division providing for automatic priority ratings are revoked and cancelled but applications for the issuance of priority certificates may still be made. The circular states, however, that such applications should be made only where the need is urgent and where it is clearly in the public interest. Under such circumstances priorities will be granted.

Among the activities classed as those in the public interest, orders from the Navy, Emergency Fleet Corporation, railroads, telegraph and telephone companies and the War Department rank first. The manufacture of farm implements, tools and machinery, the production of natural gas and petroleum with the necessary machinery for distribution, the expansion of coal mines, coking plants and ore-reduction machinery, smelters and furnaces are also included. The Priorities Division requests the industries of the country to speed up production and filling of orders for these purposes, to insure delivery when required without the necessity for priority assistance.

The circular concludes with the statement that the Priorities Division will from time to time promulgate such rulings and make such suggestions and requests in connection with priorities in the production and supply of fuel, electrical energy, labor and transportation as the changing conditions may require.

Building Industries Will Hold Atlantic City Meeting

A meeting of the National Federation of Building Industries will be held in Atlantic City, Friday and Saturday, Dec. 6 and 7. These meetings will follow the reconstruction conference and will be held in the Hotel Traymore.

The notice states that any association of architects, contractors, engineers or manufacturers and distributors of building materials who have failed to receive formal notice are invited to send delegates to act for their respective organizations.

Foreign-Trade Statistics To Be Revised and Extended

A revision and extension of the monthly, quarterly and annual foreign-trade statistics published by the bureau of foreign and domestic commerce, Department of Commerce, are announced to take effect in the near future, probably Jan. 1. More than 1500 new items will be added to the export classification, and the number of import items shown will be materially increased.

The plans now nearly completed provide for an enlarged classification for both imports and exports, instead of the two classifications at present used, and instead of the present alphabetical arrangement of items by commodities there will be a more general assembling of items under larger groups. Adaptability to mechanical tabulation also has been kept in mind in making the changes.

A bill is now in Congress providing for the publication of annual trade statistics by calendar instead of fiscal years.

Ship-Engine Contract to Kansas City Manufacturer

The United States Government has let a contract for five marine engines, each to cost $25,000, to an inland plant, owned by the Smith & Sons Co. of Kansas City, Mo., which formerly manufactured road-making machinery and is converting its plant to make these engines. The engines will be made in their entirety at the plant, and the contract must be completed by Jan. 1.

The contract was accepted under the condition that the plant could be made adaptable for production at once, it being necessary for the company to rearrange its entire plant and build a new machine shop 60 by 300 ft. in size. The shortage of steel made it necessary to construct this addition or extension entirely of wood, with only about ½ to 1 per cent. of indispensable steel.

Economic Aid to Russia Through a Government Corporation

The execution of plans to render economic aid to Russia has been intrusted by the President to the War Trade Board. To carry out or administer such details of this economic program, in regions and lines of trade where it is not possible to accomplish the desired end through the ordinary channels of trade, a corporation has been established which will be known as the War Trade Board of the United States, Russian Bureau (Inc.) The capital of the corporation, which is to be operated in the interests of the Russian people, is placed at $5,000,000.

Good Roads in Central Spain Increase Auto Traffic

Improved Financial Conditions Make Extension of Highways and Wider Use of Motors Probable

The excellent system of boulevards and roads in Madrid and the surrounding provinces of Spain invite an ever larger public to take up motoring, according to a recent commerce report. This, and the improved financial position now occupied by the nation, with its resulting increase in spending ability, make a market of increasing potential importance.

Until 1914 France was the pioneer in this territory for high-grade motor cars. Her place as Spain's nearest industrial neighbor, her ability to make deliveries of automobiles and spare parts quickly, and the quality of her production, gave her the dominant position. Another factor was the belief that the services of French mechanics were essential to the proper operation of their cars, and another was the tendency of Spanish chauffeurs and mechanics to consider a technical education incomplete without a period of practical training in the automobile factories of France. For these reasons there was only one make of American automobile in operation in central Spain up to the outbreak of the war.

Obstacles Overcome

The report states that although the extensive present sale of American machines is attributable to the war's interruption of trade currents, the success of the vehicles of medium and better grades has resulted from the efforts of several local agents in introducing the product. This result, it is pointed out, was attained in spite of certain serious obstacles arising in the United States. American manufacturers demanded payment f.o.b. factory or New York, and in other ways displayed a lack of interest in the trade, and the opportunity for building up the business in the capital and in the central region of Spain was apparently a matter of unconcern. If this passive attitude on the part of American automobile exporters persists when the return of normal conditions again permits of European competition, it is stated that a rapid loss of present trade will result.

The shortage of gasoline and the long delays in receiving cars from the United States have already produced a falling off in the business for 1918, and at the close of the war a determined effort will be made by French, English and Italian automobile manufacturers to regain the lost market. The commerce report states that a concerted

and vigorous campaign of publicity concerning the excellence of American design and construction is necessary to acquaint the Spaniard with the latest progress in the motor-vehicle industry of the United States. Spanish requirements and taste, it is pointed out, must be considered in building cars for sale in that country. Right-hand drive, a low chassis, long head, obscure body color, and the indication of tire and wheel measurements in millimeters, are among the features deemed indispensable by Madrid purchasers of motor cars.

Barcelona Invites America to Use Her Free Port Facilities

Reports indicate that America has been the first to be invited to occupy and use the free port facilities of Barcelona, Spain. The city was made a free port by royal decree about two years ago, although actual construction has not yet been started. The work is planned, however, and will be commenced on an extensive scale in the near future.

During the construction of the free zone a portion of the ordinary port will be set aside as a free zone and will be ready for use about the middle of December.

The only charge in the free zone will be for storage. This, although not definitely fixed, is not expected to exceed ½ of 1% of the value of the merchandise. The usefulness of such a port in this locality lies in its position as a distributing center for Mediterranean and near east ports.

Empl yment Service Has Placed 2,500,000 Men

The United States Employment Service, under the Department of Labor, has found places for approximately 2,500,000 workers, from the time of its organization last January to Nov. 1. The employment service has announced that the number of its officers has been increased from 90 to over 900. It is expected that the service will be used very largely in the placing of discharged soldiers and sailors.

No Marked Change in Steel Situation Yet

No visible effect is yet apparent in the local steel situation from the cessation of hostilities, according to reports received from the steel industry. An easing of the tension is felt on account of the diversion of shell and other munition steel to other lines, but the uncertainty of the future makes the market almost as inactive as when the industry was on a 100 per cent. war basis.

Bonds for Concrete Street Work Issued in New Zealand

Bonds amounting to over $600,000 have been issued by the city of Auckland, New Zealand, for the building of several miles of concrete street. This improvement, it is stated in *Commerce Reports*, will give the city from 12 to 16 miles of up-to-date streets, and there is now under construction or already financed about 23,000 sq.yd. of concreting on two thoroughfares of the city. This class of pavement, it is stated, has been found very satisfactory.

The report states that the cement plants of the country are able to supply the necessary cement for this work, but that there is an opening for American concrete-handling and other machinery for use in these improvements.

Industrial Development of India Started by War

New Plants, Including Engineering Industries, Have Created Demand for American Products

The demands of war have started a wide industrial development in India. The older activities, such as tanning, the manufacture of jute, and cotton weaving, have been enlarged and electrical appliances and machinery have been introduced. The industrial field has been widened by hydro-electric plants, iron- and steel-working and engineering industries generally, in all of which a large amount of American machinery has been used.

Shells, rivets, bolts and nuts have been produced on an extensive scale. Machines such as were never produced before in India have been made. A company has been started to manufacture brass and gun-metal work. One large firm has manufactured articles formerly imported, to a large extent, such as jute-mill machinery, lathes, steam hammers, winches and baling presses.

As an indication of this industrial activity it may be noted that a large iron and steel company, whose plant is located at a town near Calcutta, has become so extensive as to give the town the pseudonym of the "Pittsburgh of India." This development alone is due to the necessity of meeting the constantly increasing home and foreign demands. The company is engaged almost entirely on Government orders, particularly rails, but the plate- and structural-steel demand is rapidly developing in connection with the rapid growth of India's shipbuilding program. The company has a contract with the Government alone for supplying 10,000 tons of plates per annum for 10 years, and is constructing a mill capable of rolling plates of any desired length and up to 90 in. wide. The plant will contain two sets of three-high rolls with the necessary straightening rolls. It will have a capacity of about 100,000 tons per annum. In addition to this, the company is building a large structural shop, in which it will be possible to roll beams of 3 to 24 in., and a new steel-casting plant, in which steel castings up to 35 tons in weight will be poured.

Other industries have extended their operations since the war began and are preparing to expand still further after the war. These will serve to show the possibilities of the situation, and how it has appealed to India.

Industrial development has long been regarded by many in India as the necessary accompaniment of political progress, and it is now regarded as likely that a Department of Industry will be established to supervise this expansion.

Business Notes

The Missouri Valley Bridge & Iron Co., Leavenworth, Kan., has been appointed supervising engineers for the new engineers' cantonment to be constructed at Fort Leavenworth, and also for the additional coast defense cantonment at Galveston, Tex.

The John A. Stewart Electric Co., John A. Stewart, president, formerly of Cincinnati, Ohio, has opened offices in Chicago in Room 1034, 208 South La Salle St. The company will handle second-hand machinery, both electrical and steam.

At a recent special meeting of the board of directors of the Independent Pneumatic Tool Co. held in Chicago, Roger C. Sullivan was appointed a director, elected chairman of the board and member of the executive committee, to succeed John P. Hopkins, deceased.

The P. J. McHugh Paving & Construction Co., Seattle, has filed a petition for the termination of the arti les of incorporation of the concern. Members of the firm are P. J., Frank and A. McHugh, and H. M. Hood.

Trade Publications

The Moore Trench Machine Co., Rockaway, N. J., has published a 26-p. catalog, 6 x 9 in., describing the variety of uses to which its trench-working machinery can be put. It is illustrated with half tones and line cuts.

"Air and Light in Foundries and Forge Shops" is the title of a 27-p. booklet, 6 x 9 in., issued by David Lupton's Sons Co., Philadelphia. It describes and illustrates with half tones and line cuts the construction of sash types and roof formation manufactured by the company.

Two booklets have been received from the Great Western Cutting & Welding Co., San Francisco, Cal. One is entitled "Catalog No. 11," and describes and illustrates the Victor oxyacetylene cutting and welding apparatus; the other is an instruction book on oxyacetylene cutting and welding, using the Victor equipment.

EN

Dece